INSTRUCTION BOOK

21B
Automatic Direction Finder

Aircraft Radio Corporation
BOONTON, NEW JERSEY

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BOONTON, NEW JERSEY

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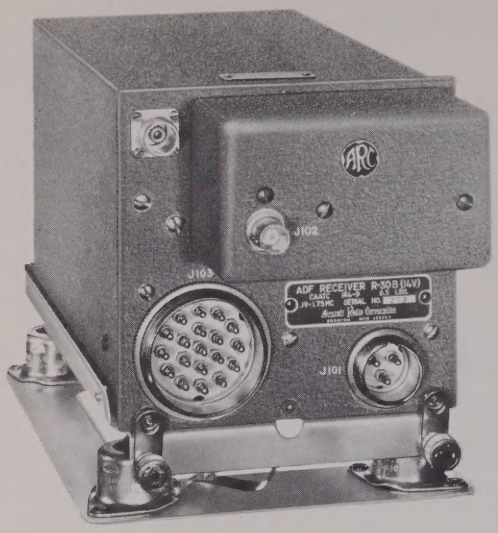
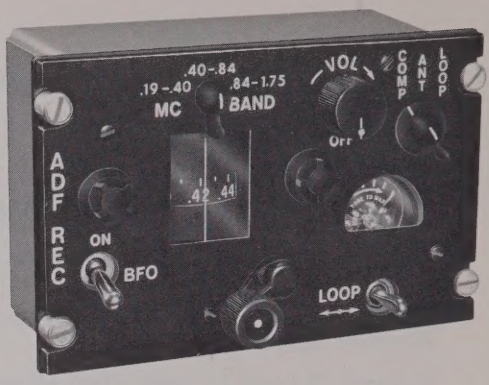
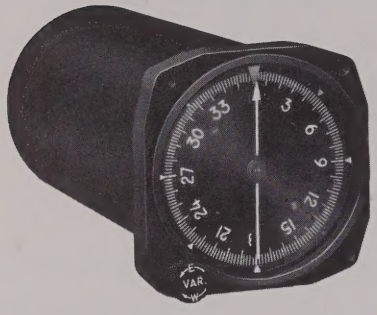


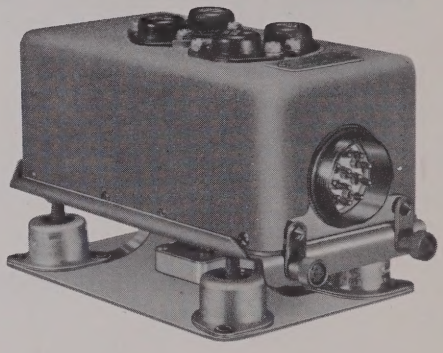
R-30B RECEIVER WITH
M-26A MOUNTING



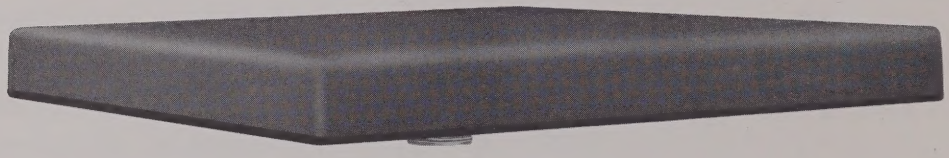
C-59A CONTROL UNIT



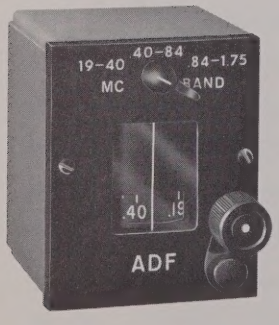
IN-21C GONIOMETER-INDICATOR



DV-14A DYNAVERTER
WITH M-28A MOUNTING

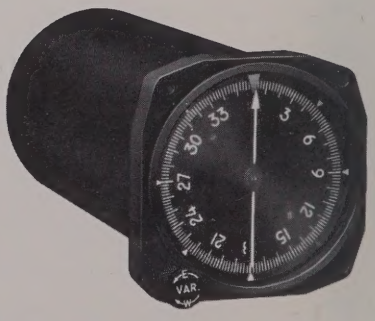


L-40B LOOP ANTENNA



CC-14A CONTROL UNIT

CC-15A CONTROL UNIT



IN-21B GONIOMETER-INDICATOR

TP1642

Figure 1–1. 21B Automatic Direction Finder, Major Units

SECTION I
GENERAL INFORMATION

1–1. INTRODUCTION.

This instruction book contains installation, operation, principles of operation, and maintenance information for the 21B Automatic Direction Finder, manufactured by Aircraft Radio Corporation, Boonton, New Jersey.

1–2. PURPOSE.

The 21B is a remotely controlled automatic direction finder set which provides a continuous, visual bearing indication of the direction from which a radio signal is being received. The set can be used for plotting position, homing, aural reception of amplitude-modulated signals, and aural identification of keyed CW signals. It operates in the frequency range of 190 to 1750 kc, divided into three bands: 190 to 400 kc, 400 to 840 kc, and 840 to 1750 kc.

1–3. SPECIFICATIONS.

General.

Frequency Range:	190–1750 kc
Frequency Bands:	190–400 kc, 400–840 kc, 840–1750 kc
Band Switching:	Electrical, remote-control
Tuning:	Mechanical, remote-control
Types of Operation:	COMP: Automatic direction finder using both sense and loop antennas ANT: Communication receiver using sense antenna only LOOP: Manual direction finder using loop antenna only
Total Input Power:	4.3 amperes at 13.75 volts dc 2.1 amperes at 27.5 volts dc

Environmental Characteristics:[1]

Temperature:	Not Operating: −62°C to +71°C Operating: −54°C to +55°C
Altitude:	55,000 feet maximum
Humidity:	Up to 100% at temperatures up to 50°C
Vibration:	.030 inch total excursion (.020 inch for IN-21B and IN-21C) from 10 to 55 cps; 5 G acceleration (1.5 G for IN-21B and IN-21C) from 55 to 500 cps
Shock:	Crash Safety: 15 G Operating: 6 G
Audio Frequency Susceptibility:	Meets Category A of RTCA Paper 120-61/DO-108
Radio Frequency Susceptibility:	Meets Category A of RTCA Paper 120-61/DO-108
Spurious Energy Emission:	Meets Category A of RTCA Paper 120-61/DO-108
Explosion:	Will not cause an explosion in an explosive atmosphere
Certification:	FAA TSO C41b, Class A, Category AAAAAAE for R-30B and M-26A, C-59A, DV-14A and M-28A, L-40B; Category AABAAAE for IN-21B, IN-21C

[1]For R-30B and M-26A, C-59A, DV-14A and M-28A, L-40B, IN-21B, and IN-21C.

Receiver.

Sensitivity:	ANT (MCW): 4 to 10 μv in series with 50-pf capacitance through standard input cable of 100 pf for a 6 db S+N/N output ratio COMP: 10 to 25 μv/meter for a maximum of 2 degrees error and ±2 degrees jitter LOOP (CW): 20 to 100 μv/meter for 6 db S+N/N ratio (goniometer rotor rotated to obtain maximum pickup) LOOP (MCW): 50 to 100 μv/meter for 6 db S+N/N ratio (goniometer rotor rotated to obtain maximum pickup)
Image Rejection:	At 190 kc, greater than 110 db; at 379 kc, greater than 100 db; at 1750 kc, greater than 70 db
I-f Rejection:	At 190 kc, greater than 85 db; at 1750 kc, greater than 100 db
Band Width:	At 6 db, 1.6 to 2.8 kc; at 60 db, 4.2 to 8.5 kc (kc off resonance, modulated 30 percent at 100 cps, depending on frequency from 190 to 1750 kc)
A-f Power Output:	300 mw into 300 ohms
Intermediate Frequency:	142.5 kc
Mounting:	M-26A

Dynaverter.

Input Power:	2.0 amperes at 13.75 volts dc 1.75 amperes at 27.5 volts dc
Output Power:	100 ma at 125 volts dc 800 ma at 13 volts, 100 ±3 cps
Mounting:	M-28A

1–4. UNITS AND ACCESSORIES.
Table 1–1 lists the units and accessories of the 21B Automatic Direction Finder. The major units are illustrated in Figure 1–1.

TABLE 1–1. UNITS AND ACCESSORIES

UNITS

Qty	Name	Type No.	Part No.	Over-all Dimensions (inches)			Weight (pounds)
				Height	Width	Depth	
1	Receiver[1]	R-30B	34850-0014	4½	4 9/16	10 5/8	6.7
			34850-0028	4½	4 9/16	10 5/8	6.7
1	Control Unit[1]	C-59A	20500-0014	3¾	5¾	3¾	1.64
			20500-0028	3¾	5¾	3¾	1.64
1	Control Unit[2]	CC-14A	26891	3	2 15/32	4	0.87
1	Control Unit[2]	CC-15A	26904	3	2 15/32	3¼	0.75
1	Dynaverter[1]	DV-14A	24630-0014	3 1/32	3⅜	6⅞	3.5
			24630-0028	3 1/32	3⅜	6⅞	3.5
1	Goniometer-Indicator	IN-21B[3]	32670	3¼	3¼	7¾	2.2
		IN-21C	33550	3¼	3¼	7¾	1.9
1	Loop Antenna	L-40B	34390	1 11/16	9½	9½	4.4
1	Mounting	M-26A	21660	1 11/16	5 3/16	9 3/32	0.6
1	Mounting	M-28A	21650	1¾	4⅛	7 3/16	0.6

ACCESSORIES

Qty	Name	Type No.	Part No.	Weight (pounds)
2	Connector	—	16115	0.18
1	Connector	—	16742	0.12
1	Connector[4]	—	27818-0005	0.06
1	Connector[4]	—	27818-0014	0.06
1	Connector	—	33979	0.09
—	Custom Control Parts[2]	—	—	—
1	Crank	—	10021	0.47
1	Dial Gearing Unit	—	18639	—
1	Knob	—	20562	—
1	Knob	—	5444	—
1	Mask	—	18971	—
1	Ring	—	18546	—
4	Screw	—	143-0012	—
3	Screw	—	144-0024	—
3	Screw	—	152-0016	—
6	Spacer	—	5394	—
1	Switch	—	19982	0.06
1	Tuning Meter	—	18428	0.09
1	Loop Antenna Cable Assembly (20 feet)	—	32803	1.2
AR	Mechanical Linkage[5]	—	16158	0.12/ft
1	Panel[6]	—	27027	0.09
2	Plate[4]	—	27029	0.06
1	Receiver Cable Assembly[7] (10 feet)	—	33785-0010	0.5
	(20 feet)	—	33785-0020	0.9
	(30 feet)	—	33785-0030	1.3
1	Remote Control Kit[9] consisting of:	KT-21A	33310	4.05
1	Actuator	PA-12A	33300	—
1	Cable Clamp	—	31724-0003	—
1	Connector Assembly	—	31723	—
1	Connector Assembly	—	33735-0003	—
1	Controller	C-110A	33290	—
1	Mounting	M-20A	21756	—

TABLE 1–1. UNITS AND ACCESSORIES — Continued

ACCESSORIES — Continued

Qty	Name	Type No.	Part No.	Weight (pounds)
1	Sense Antenna Cable Assembly[8] (7 feet)	—	17984-0000	0.31
	(14 feet)	—	18637-0000	1.06
1	Sense Antenna Kit[9] consisting of:	—	19210	0.34
1	Antenna Wire (30 feet)	—	12447	—
1	Connector	—	19356	—
2	Insulator	—	12443	—
1	Insulator Assembly[10]	—	19077	—
1	Shackle	—	19357	—
1	Spring	—	12413	—
4	Thimble	—	12342	—

[1]14- or 28-volt unit supplied as specified.
[2]Optional; available on special order as substitute for C-59A.
[3]Optional; used if remote bearing indicator is required.
[4]Optional; used with CC-14A and CC-15A Control Units.
[5]Supplied assembled or unassembled as ordered. To complete part number, specify length in inches.
[6]Optional; used for mounting CC-14A and CC-15A in AN console.
[7]10-, 20-, or 30-foot cable length supplied as specified.
[8]7- or 14-foot cable length supplied as specified.
[9]Optional; supplied on special order.
[10]Available as separate item.

1–5. DESCRIPTION OF UNITS.

Receiver. The R-30B Receiver is a superheterodyne receiver covering the frequency range of 190 to 1750 kc in three bands. The desired band is selected through remote control of a band-switching motor operated by a switch located in the control unit. The receiver is tuned remotely by the control unit through mechanical linkage or, if the optional remote control kit is used, through electro-mechanical linkage.

For automatic direction finding, the receiver uses both the loop and sense antennas. For other functions, the receiver uses either antenna alone. Keyed CW stations are identified by the use of a beat frequency oscillator (BFO) which is included in the receiver. The BFO is a hermetically sealed, transistorized subassembly using an NPN silicon transistor.

Subminiature tubes and wired-in replaceable subassemblies are used in the receiver. The i-f/a-f section is constructed on a hinged chassis. The tuning capacitor is a five-section, ganged, variable capacitor constructed so that its capacitance decreases with a temperature rise. This tuning capacitor, operating with fixed compensating capacitors, assures stable operation over a wide frequency range. There is a negligible change in sensitivity and selectivity over the temperature range of $-55°C$ ($-67°F$) to $+71°C$ ($+159.8°F$). The i-f section (tuned to 142.5 kc) consists of three double-tuned transformers and two electron tubes. Fifteen r-f transformers are used in the r-f section, five for each frequency band. All r-f and i-f transformers are preset in inductance, filled with nitrogen, and hermetically sealed. The a-c and high-voltage d-c potentials required for operation are obtained from the Dynaverter. All electrical and mechanical connections to the receiver are made through connectors on the front panel. The receiver requires an M-26A Mounting for installation.

Loop Antenna. The L-40B Loop Antenna consists of two insulated coils wound at right angles to each other on a flat ferrite core. The high permeability of the ferrite core concentrates the r-f field in the loop coils resulting in a sensitivity equal to an air-core loop antenna many times larger. The symmetrical winding of the loop coils provides a balanced receiving capability in all directions. The coils and ferrite core are encapsulated in lightweight foam and housed in a hard plastic shell. The ruggedly constructed loop antenna is mounted on the exterior surface of the aircraft. The forward direction is marked on the side of the loop antenna. Electrical connections are made through a seven-pin connector.

Control Unit. The C-59A Control Unit is an edge-lighted plastic panel, console-type control assembly for the 21B ADF. It includes a tuning crank, a tuning meter, a primary power on-off switch and volume control (VOL), a band selector switch (MC BAND), a function selector switch, a switch for controlling the goniometer rotor rotation (LOOP), and a beat frequency oscillator switch (BFO).

The tuning crank is used for remote tuning of the receiver; the tuning meter provides a visual indication of the accuracy of the tuning. The VOL control is a dual potentiometer and switch combination. The switch controls the application of primary voltage to the 21B ADF.

One of the potentiometer sections is used as an audio gain control, while the other is used as an r-f sensitivity control.

The MC BAND switch actuates a masking drum which surrounds the frequency dial drum and allows only the selected band to be visible. The MC BAND switch also controls the operation of a d-c motor on the front of the receiver. This motor is geared through a 4000:1 gear train to a six-gang wafer switch in the r-f section of the receiver.

The function switch is a three-position rotary switch. When this switch is in the COMP position, both the loop and sense antennas are used, and the receiver functions as an automatic direction finder; also, the loop and modulating circuits of the receiver are energized, full avc is switched in, and the VOL control regulates the audio gain. When the function switch is in the ANT posititon, only the sense antenna is used, and the receiver functions as a low-frequency range receiver. Under this condition, the loop and modulating circuits of the receiver do not operate, and the VOL control functions as an audio gain control and an r-f sensitivity control to eliminate the avc action. The removal of avc permits the detection of small changes in signal strength for low-frequency range navigation. The LOOP position of the function switch is used when it is desired to use only the loop antenna for reception. This position allows the ADF set to be used as a manual direction finder, or it allows the loop antenna to be used instead of the sense antenna for radio range reception during heavy static conditions.

The LOOP switch is used to position the goniometer rotor electrically when the function switch is in the LOOP position. When the function switch is in the COMP position, the LOOP switch is used to determine whether the goniometer-indicator reading is produced by a reliable signal. The LOOP switch is a spring-loaded, double-throw, center-off toggle switch. When actuated, a test voltage is applied to the servo amplifier of the receiver, driving the goniometer-indicator pointer in the direction in which the switch is held (left or right). This test voltage overrides the signal circuits, and the pointer of the goniometer-indicator rotates independently of the received signal, away from its original position. When the LOOP switch is released, the pointer should return to its original position. This test assures the operator that the ADF set is operating properly, and that the received signal is strong enough to duplicate the goniometer-indicator reading whether approached from a clockwise or counterclockwise direction.

The BFO switch controls the operation of the beat frequency oscillator included in the receiver. When the BFO switch is in the ON position, B+ is connected to the beat frequency oscillator, placing it in operation to permit identification of keyed CW stations. With the BFO switch in the off position (down position), B+ is removed from the beat frequency oscillator and only voice- or tone-modulated signals may be identified.

Optional Control Units. The optional CC-14A and CC-15A Control Units, shown in Figure 1–1, duplicate the operation and function of the C-59A Control Unit. The operation and function of the C-59A Control Unit may also be duplicated with a custom control panel installation, using the parts listed in Table 1–1.

Indicators. The IN-21C Goniometer-Indicator is normally supplied with the 21B ADF; however, if a remote bearing indicator is required, an IN-21B Goniometer-Indicator is used.

The IN-21C Goniometer-Indicator contains an r-f goniometer, servo motor, compensation mechanism, and gearing unit. The goniometer-indicator is graduated every 2°, with major markings every 10° and numerical markings every 30°. The dial is positioned by a variation knob (VAR.) located on the front of the goniometer-indicator.

The IN-21C Goniometer-Indicator differs from the IN-21B Goniometer-Indicator only in that the IN-21B contains a synchro transmitter which permits its bearing indication to be repeated on conventional bearing indicators, such as the single-pointer IN-12-1 (part no. 27310), double-pointer IN-13A-1 (part no. 27470), or IN-16A RMI (part no. 27226).

In both goniometer-indicators, the internal wiring is determined by the location of the loop and sense antennas. The goniometer-indicators are factory-wired for a top sense antenna and a bottom loop antenna installation. Any other combination of antenna locations requires that simple wiring changes be made within the goniometer-indicators. The wiring changes, if required, should be made before installation of either goniometer-indicator is started.

Dynaverter. The DV-14A Dynaverter is a transistorized power converter that furnishes all a-c and d-c voltages (except primary power) required for operation of the ADF set. A two-transistor multivibrator switching circuit and a full-wave rectifier generate the high d-c voltages. The filter circuit for the high-voltage d-c output is a capacitor-input filter using two chokes in series and a capacitor connected across the output. A two-transistor oscillator and a two-transistor, push-pull power amplifier generate the 100-cps a-c voltages.

The Dynaverter requires an M-28A Mounting for shock-mount installation. Electrical connections are

made to the unit through a connector on the front panel of the unit.

Mountings. The M-26A Mounting is used for shock-mounting the receiver and the M-28A Mounting is used for shock-mounting the Dynaverter. Each mounting is equipped with two nut and link arrangements which engage cone-shaped studs on the receiver and Dynaverter to secure the units in place.

1–6. DESCRIPTION OF ACCESSORIES.

Connectors. Two 16115 connectors, a 16742 connector, and a 33979 connector are used to fabricate the interconnecting cable assembly. Connectors 16115 mate with J103 of the receiver and J201 of the control unit. Connector 16742 mates with J701 of the Dynaverter. Connector 33979 mates with J2 of either the IN-21B or IN-21C Goniometer-Indicator.

Connector 27818-0005 and Connector 27818-0014 are required when the optional CC-14A and CC-15A Control Units are used. Connector 27818-0005 mates with J1 of the CC-14A and Connector 27818-0014 mates with J1 of the CC-15A.

Loop Antenna Cable Assembly. Loop Antenna Cable Assembly 32803 is used to connect the loop antenna to the goniometer-indicator. It is 20 feet long, and it is terminated at one end with a 32806-0001 connector and at the other end with a 32805-0001 connector.

Mechanical Linkage. Mechanical Linkage 16158 consists of flexible shafting within an outer casing which is terminated at each end with a splined coupling. It is connected between the control unit and the receiver for remote, mechanical tuning of the receiver. It may be supplied assembled or in kit form, as specified. Assembly instructions are included with the W-10 Mechanical Linkage Tool (16200) which is available on special order.

Panel and Plate. Panel 27027 is used when the optional CC-14A and CC-15A Control Units are mounted in an AN console. Plate 27029 is used when the optional CC-14A and CC-15A are mounted in an instrument panel whose thickness is other than $\frac{1}{16}$ inch.

Receiver Cable Assembly. Receiver Cable Assembly 33785 is used to connect the receiver to the goniometer-indicator. The cable, terminated at one end with Connector 33758 and at the other end with Connector 33874, is available in a 10-foot length (33785-0010), 20-foot length (33785-0020), or 30-foot length (33785-0030).

Remote Control Kit. The KT-21A Remote Control Kit (33310) is the electrical equivalent of mechanical linkage and may be used in its place for remote-control tuning of the receiver.

When the relative positions of the receiver and its control unit require a long length of mechanical linkage, backlash and binding produced in the mechanical linkage affect the tuning of the receiver. The kit provides positive-drive and accurate tuning of the receiver.

Sense Antenna Cable Assembly. Either Sense Antenna Cable Assembly 17984-0000 or Sense Antenna Cable Assembly 18637-0000 is used to connect the sense antenna to the receiver. Sense Antenna Cable Assembly 18637-0000 is a 14-foot length of RG-114A/U coaxial cable terminated at each end with a 18767 connector. Sense Antenna Cable Assembly 17984 is a 7-foot length of RG-62/U coaxial cable terminated at each end with a UG-260/U (12955) connector. Each sense antenna cable assembly has a capacity of 100 $\pm$5 pf.

Sense Antenna Kit. Sense Antenna Kit 19210 includes all the parts necessary for constructing and installing a sense antenna. Insulator Assembly 19077 is supplied with the sense antenna kit; it may also be supplied separately. The insulator assembly is used for coupling the sense antenna to the sense antenna cable assembly. It is desirable that this insulator assembly, or its equivalent, be used to retain the electrical characteristics of the antenna cable assembly.

SECTION II
INSTALLATION

2–1. UNPACKING.

Carefully remove the equipment from the packing case. Inspect each unit for damage. Be sure the operating controls on the control unit and goniometer-indicator function properly. Check the units and accessories against the packing slip to be sure all items have been removed from the packing case.

2–2. INSTALLATION CONSIDERATIONS.

General. The location and installation of the units will depend on the type of aircraft in which the equipment is to be installed; however, the following requirements apply to all types of aircraft.

Unit Dimensions and Installation Area. Installation dimensions are shown in Figures 2–1 through 2–12. Compare the space requirements of each unit with the area being considered. Locate the units so that they are accessible for inspection and maintenance and in an area free from excessive vibration and heat.

Location of Control Unit, Receiver, and Dynaverter. Install the control unit so that it is within convenient view and reach of the operator. The receiver and Dynaverter may be installed in any convenient location. Allow sufficient clearance on all sides of each shock-mounted unit for shock-mount travel and ventilation, and sufficient space in front of each unit to permit easy removal from its mounting. Allow enough space for cable and external wiring connections to be made, and arrange the cable and wiring so as not to restrict shock-mount travel.

Location of Goniometer-Indicator. The goniometer-indicator should be installed on a shock-mounted instrument panel within convenient view and reach of the operator. Allow at least 2½ inches of open space at the rear of the unit for installing the connector. The receiver cable assembly, which connects the goniometer-indicator to the receiver, is available in a 10-, 20-, or 30-foot length. Regardless of the cable used, its length should not be altered.

Location of Loop Antenna. The loop antenna may be mounted on either the top or bottom of the aircraft, but should be located as near as possible to the centerline of the aircraft. The loop antenna should be kept away from other antennas and structural members which may cause distortion of the radio field pattern. Because the length of the loop antenna cable assembly is critical and cannot be altered, the distance between the loop antenna and the goniometer-indicator must not exceed the cable length of 20 feet.

Characteristics of Sense Antenna. It is difficult to obtain optimum antenna arrangements on any but the largest aircraft, and even then certain compromises are to be expected. An ADF usually performs satisfactorily using a "standard" range antenna. A satisfactory type of wire antenna is the balanced or symmetrical-T, although an inverted-L or unbalanced-T may also provide acceptable results. The balanced-T antenna is not responsive to horizontally polarized transmissions and is therefore preferred to the inverted-L. (Response to horizontal radiation is undesirable where accurate indications of over-station position are required.) The sense antenna may be mounted on either the top or bottom of the aircraft, but should be located as near the centerline as possible. The flat-top portion of the antenna should not be less than 8 feet in length. A length up to 12 feet may give increased performance. A longer sense antenna will provide better communication-receiver sensitivity, but may result in sluggish ADF operation. The average clearance between the antenna and the skin of the aircraft should be 10 inches or more.

Depending on the location of the sense antenna, the feed-through insulator for the sense antenna should be mounted on either the top or bottom of the aircraft, as near as possible to the midpoint of the aircraft.

The sense antenna cable assembly is supplied in either a 7-foot or 14-foot length. (Where extremely short runs are encountered, it may be more convenient to fabricate a 3½-foot section of RG-58/U cable locally, although no performance advantage would result.) Each of the sense antenna cables has a capacitance of 100 pf. To

maintain proper antenna tuning, the length of these cables must not be altered. The 7-foot cable is preferable because of its lighter weight, flexibility, and ruggedness.

2–3. INSTALLATION OF RECEIVER AND MOUNTING.

Installation dimensions for the R-30B Receiver installed on the M-26A Mounting are shown in Figure 2–1. The surface used for installing the mounting should be clean, bare metal to ensure proper grounding of the units. To install the receiver and mounting, proceed as follows:

Step 1. Drill aircraft mounting surface for eight No. 8-32 screws, located as shown in Figure 2–1.

Note

The mounting may be used as a template for locating the mounting holes.

Step 2. Place mounting in position and secure.

Step 3. Loosen knurled thumbnuts on front of mounting so that links point down. Slide receiver onto mounting. Press down near front of receiver, rotate links so that their holes engage conical studs, and tighten thumbnuts.

2–4. INSTALLATION OF CONTROL UNIT.

Installation dimensions for the C-59A Control Unit are shown in Figure 2–2. The C-59A is designed for installation on a standard AN console panel. It is secured to the panel by four Dzus fasteners.

Installation dimensions and assembly details for the CC-14A and CC-15A Control Units are shown in Figures 2–3, 2–4, and 2–5.

Note

The CC-14A and CC-15A are factory-wired for 28-volt operation. To modify for 14-volt operation, see Figures 6–11 through 6–14.

Installation dimensions for the custom control parts, listed in Table 1–1, are shown in Figures 2–6, 2–7, and 2–8.

2–5. INSTALLATION OF GONIOMETER-INDICATOR.

Installation dimensions for the IN-21B and IN-21C Goniometer-Indicators are shown in Figure 2–9. Before installing either unit, check that the internal wiring is correct for the selected loop and sense antenna locations, as specified on the interconnection diagram, Figure 2–13. If a remote bearing or RMI indicator, such as the IN-12-1, IN-13A-1, or IN-16A, is to be installed, the following conditions must be met:

a. An IN-21B Goniometer-Indicator is required.

b. The synchro transmitter in the IN-21B and the synchro receiver in the remote indicator must be excited by an a-c power source for which they are designed.

c. The IN-12-1, IN-13A-1, and IN-16A indicators require either 13 volts, 100 cps, which may be supplied by the Dynaverter of the 21B ADF, or an externally generated 26 volts, 400 cps.

d. Military indicators, such as the ID-250, require 26 volts, 400 cps for proper operation.

2–6. INSTALLATION OF DYNAVERTER AND MOUNTING.

Installation dimensions for the DV-14A Dynaverter, installed on the M-28A Mounting, are shown in Figure 2–10. To install the Dynaverter and its mounting, proceed as follows:

Step 1. Drill aircraft mounting surface for eight No. 6-32 screws as shown in Figure 2–10.

Note

Bottom plate of mounting may be used as a template for locating the mounting holes.

Step 2. Place mounting in position and secure.

Step 3. Loosen knurled thumbnuts on front of mounting so that links point down. Slide Dynaverter on mounting. Press down near front of Dynaverter, rotate links so that their holes engage conical studs, and tighten thumbnuts.

2–7. INSTALLATION OF SENSE ANTENNA.

The sense antenna may be fabricated from Sense Antenna Kit 19210, which is available on special order. General installation requirements are discussed in paragraph 2–2 and are shown in Figure 2–11.

2–8. INSTALLATION OF LOOP ANTENNA.

A position of minimum radio frequency error should be selected for installation of the L-40B Loop Antenna. Installation dimensions for the loop antenna are shown in Figure 2–12. To install the loop antenna, proceed as follows:

Step 1. Fabricate the required interconnecting cable assemblies and mechanical linkage (refer to paragraph 2–9).

Step 2. Interconnect the units as shown in Figure 2–13, routing Loop Antenna Cable Assembly 32803

through aircraft door or window opening to permit full movement of loop antenna.

Step 3. With aircraft positioned in an area clear of all objects which may cause distortion or reflections of received signal, turn on receiver and tune to a station having a known magnetic compass bearing. Align 0° of dial at index on goniometer-indicator.

Note

Station selected should be at least 60 miles distant, static-clear, and operating below 500 kc.

Step 4. Using a magnetic compass, align centerline of aircraft with known station bearing. Cage DG (directional gyro), adjust to 0°, and uncage.

Step 5. Using DG, turn aircraft to a heading of 315°.

Step 6. Move loop antenna forward and backward along centerline of aircraft until goniometer-indicator indicates, as close as possible, 45°. Make certain centerlines of aircraft and loop antenna are aligned, and forward edge of loop antenna faces nose of aircraft.

Step 7. Using DG, turn aircraft to a heading of 0° and check that goniometer-indicator indicates 0 ±5°.

Step 8. If error is greater than ±5°, rotate loop antenna slightly until error is within limits.

Step 9. Mark final position of loop antenna. Remove loop antenna, and drill mounting holes in skin of aircraft as shown in Figure 2–12.

Step 10. Using four No. 10-32, corrosion-resistant, binding head screws, ⅝ inch long, secure loop antenna in position.

Note

A doubler plate, such as that shown in Figure 2–12, should be used to install the loop antenna. After the required mounting holes for the loop antenna have been drilled, attach the doubler plate to the inside surface of the aircraft skin. Securing the doubler plate to the aircraft skin allows the loop antenna to be removed and reinstalled easily.

Step 11. Reroute loop antenna cable assembly inside aircraft and connect to loop antenna.

Step 12. Perform the loop compensation procedures described in paragraph 2–10 (page 19).

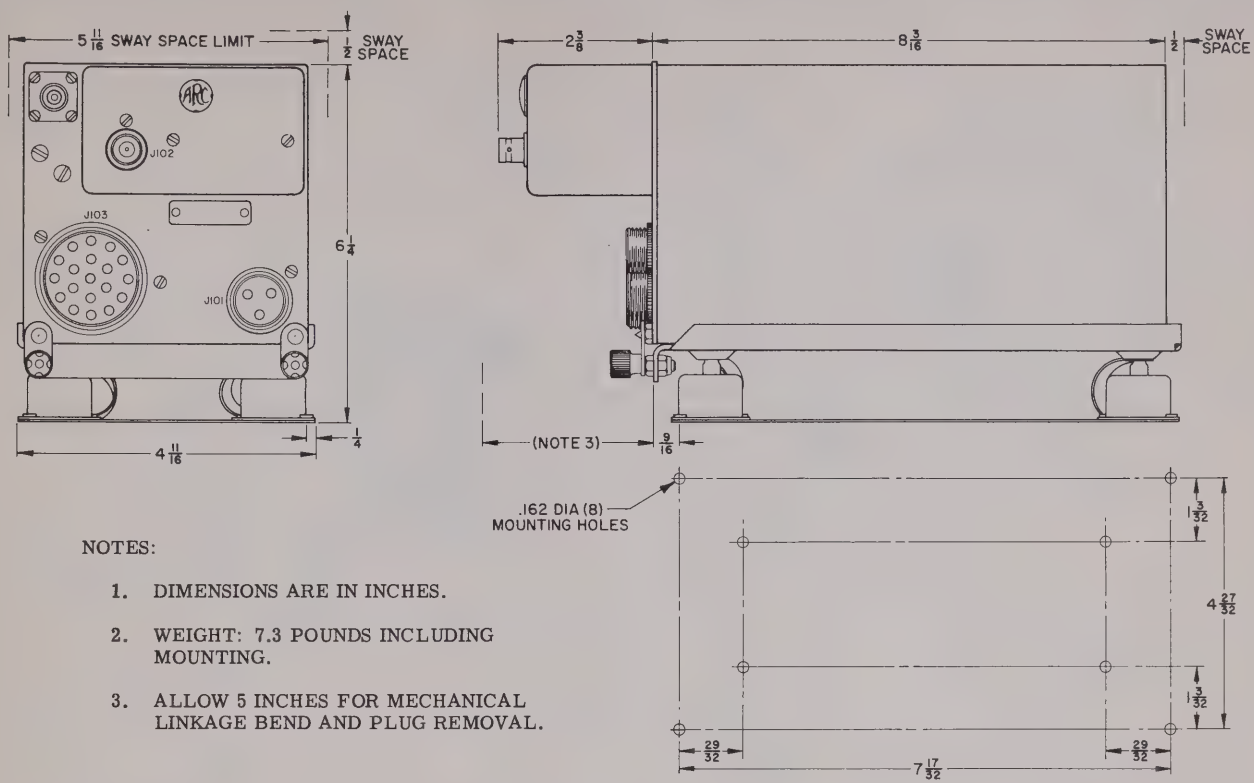
2–9. INTERCONNECTION OF UNITS.

The units are supplied ready for installation, except for the goniometer-indicator which may require internal rewiring as determined by the relative mounting positions (top or bottom) of the loop and sense antennas. R-f cables are supplied which interconnect the loop antenna to the goniometer-indicator, the goniometer-indicator to the receiver, and the receiver to the sense antenna. All other cables are fabricated using individual wires (not supplied) and the connectors listed in Table 1–1.

A suitable length of Mechanical Linkage 16158, for remote-control tuning of the receiver by the control unit, is also required. A specified length may be supplied or parts are available for field fabrication. Assembly instructions are included with the W-10 Mechanical Linkage Tool which is available as a separate item.

An interconnection diagram is shown in Figure 2–13.

(Text continued on page 19)

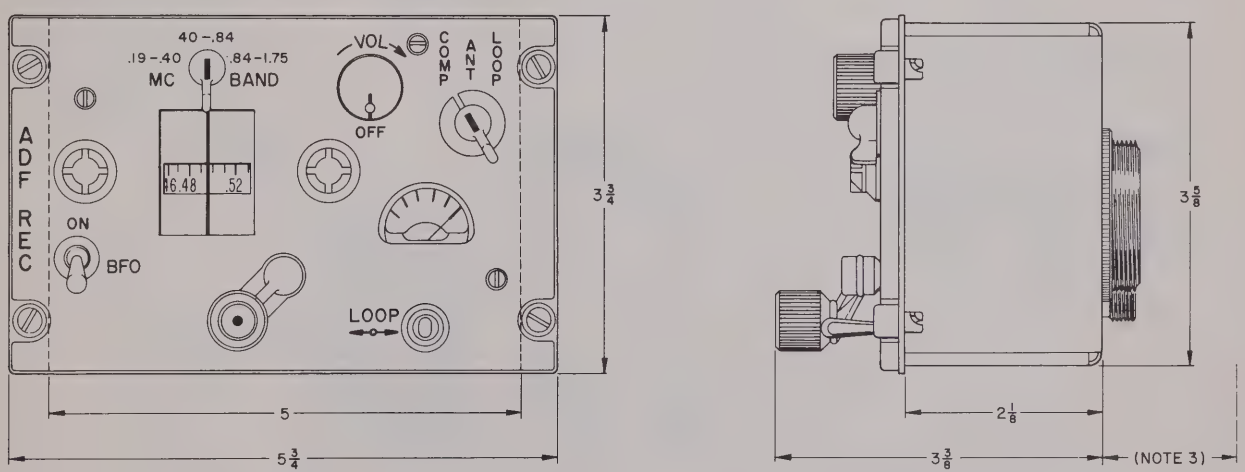


NOTES:

1. DIMENSIONS ARE IN INCHES.
2. WEIGHT: 7.3 POUNDS INCLUDING MOUNTING.
3. ALLOW 5 INCHES FOR MECHANICAL LINKAGE BEND AND PLUG REMOVAL.

TP1385A

Figure 2–1. R-30B Receiver with M-26A Mounting, Installation Dimensions

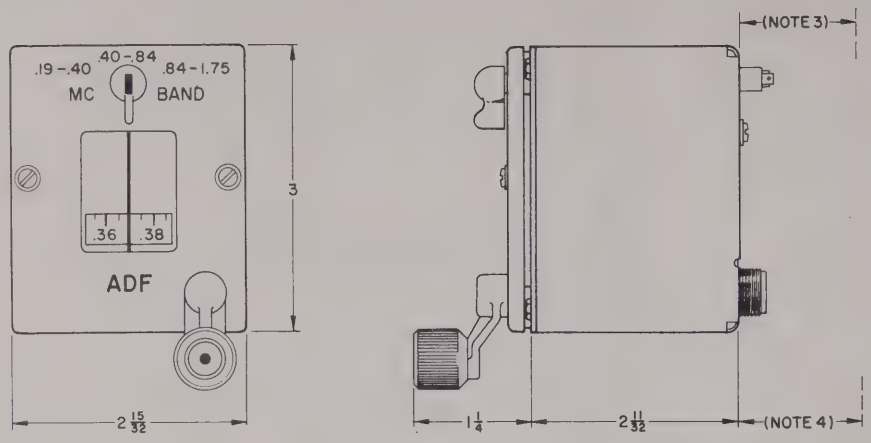


NOTES:

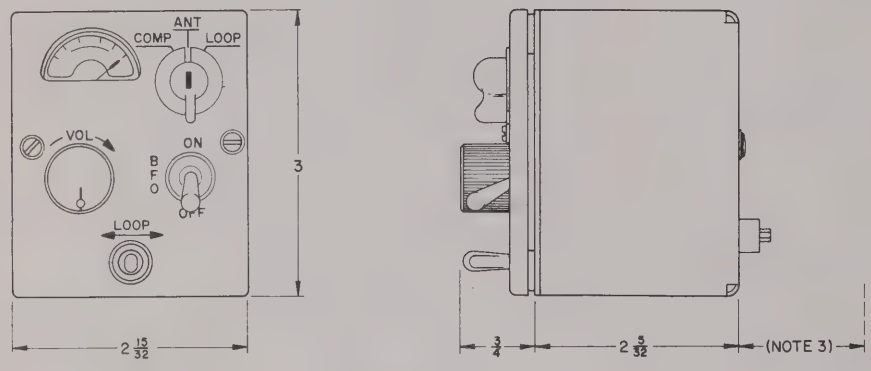
1. DIMENSIONS ARE IN INCHES.
2. WEIGHT: 1.64 POUNDS.
3. ALLOW 5 INCHES FOR MECHANICAL LINKAGE BEND AND PLUG REMOVAL.

TP1391A

Figure 2–2. C-59A Control Unit, Installation Dimensions



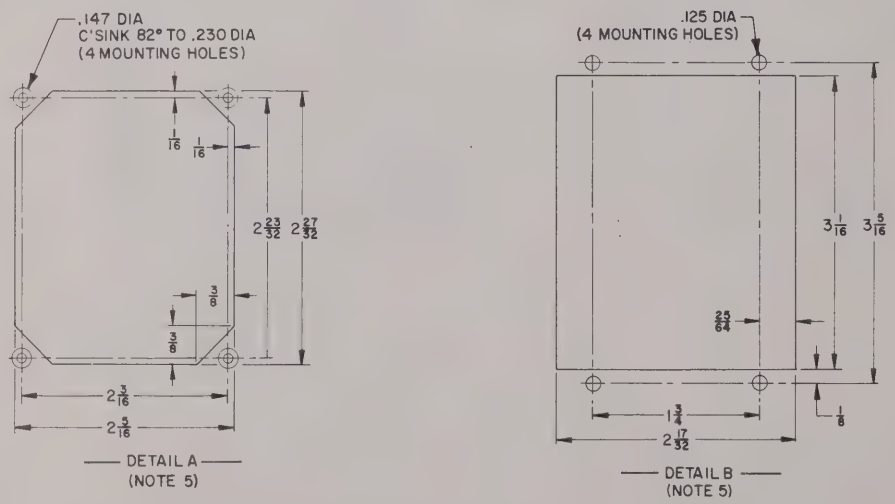
CC-14A CONTROL UNIT



CC-15A CONTROL UNIT

NOTES:

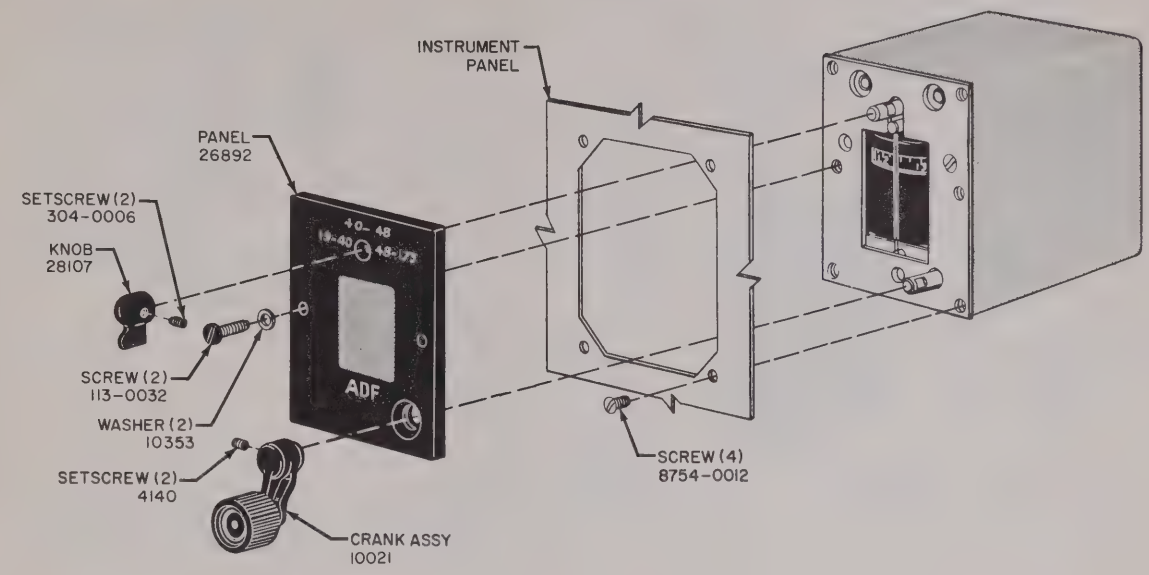
1. DIMENSIONS ARE IN INCHES.
2. WEIGHT: CC-14A: 0.87 POUND; CC-15A: 0.75 POUND.
3. ALLOW 2-1/2 INCHES FOR PLUG REMOVAL.
4. ALLOW 5 INCHES FOR MECHANICAL LINKAGE BEND.
5. CC-14A AND CC-15A MOUNT DIRECTLY ON 1/16-INCH INSTRUMENT PANEL. UNITS REQUIRE ADAPTER PLATE IF PANEL IS OTHER THAN 1/16 INCH THICK. USE CUTOUT DIMENSIONS, DETAIL A, FOR DIRECT PANEL MOUNTING; USE CUTOUT DIMENSIONS, DETAIL B, FOR MOUNTING UNIT WITH ADAPTER PLATE.



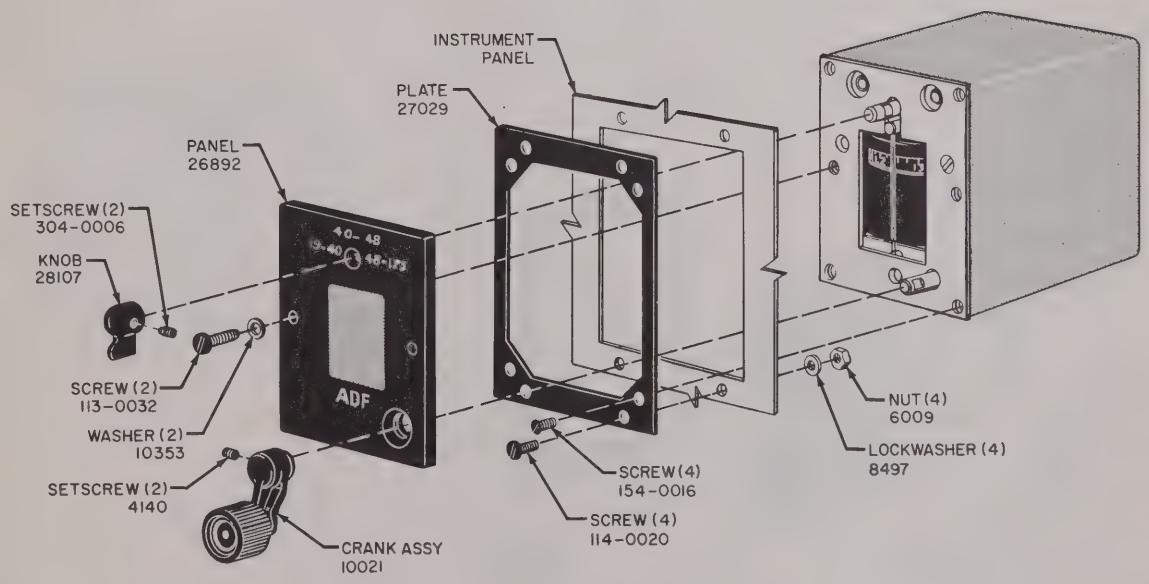
PANEL CUTOUT

TP4339

Figure 2–3. CC-14A and CC-15A Control Units, Installation Dimensions



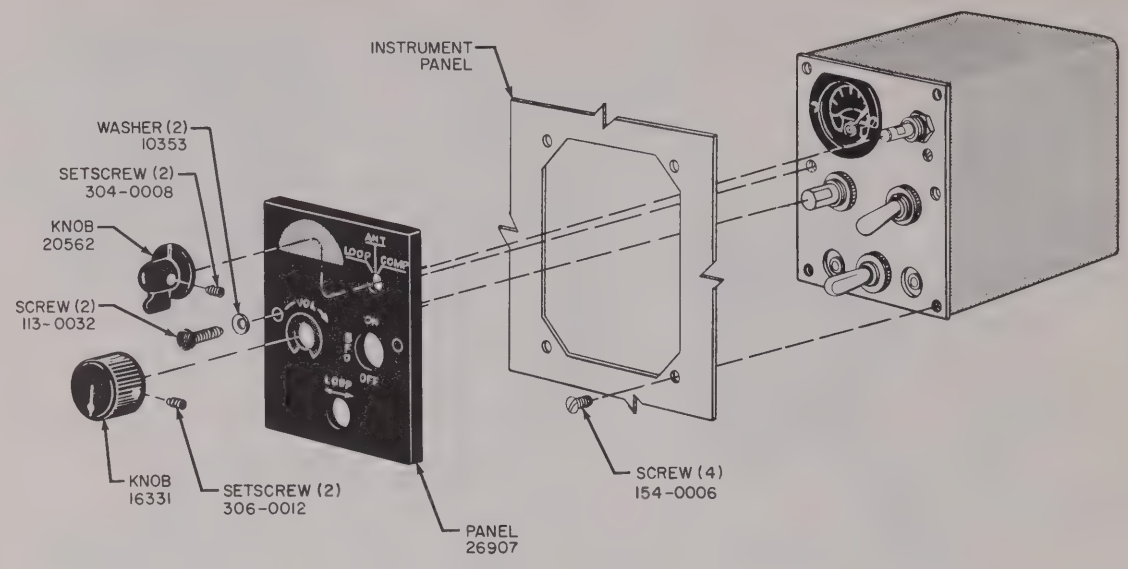
— A. WITHOUT ADAPTER PLATE —



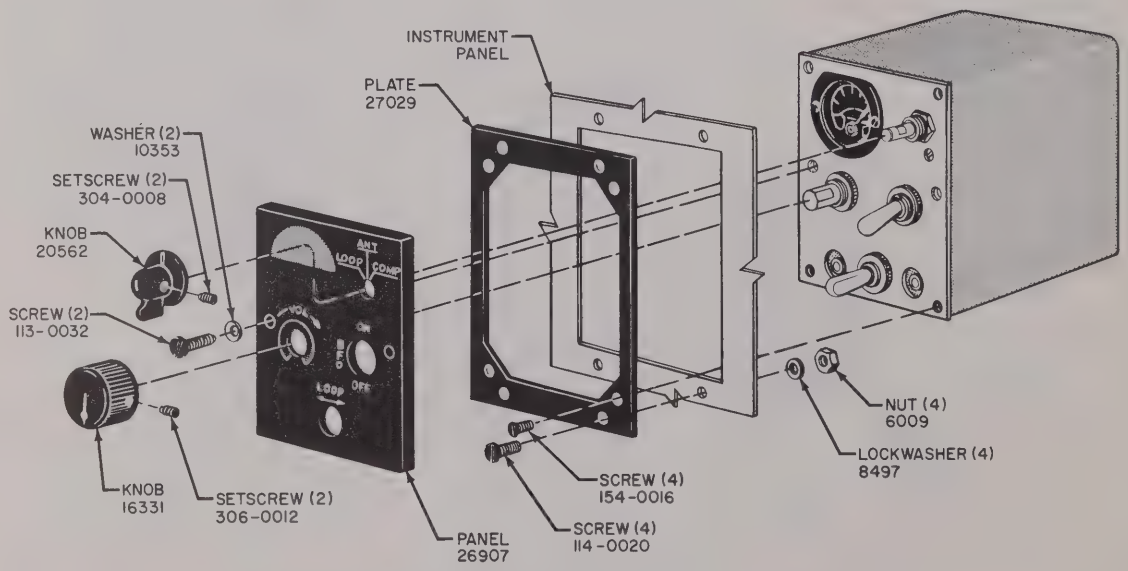
— B. WITH ADAPTER PLATE —

TP4341

Figure 2–4. CC-14A Control Unit, Assembly Details



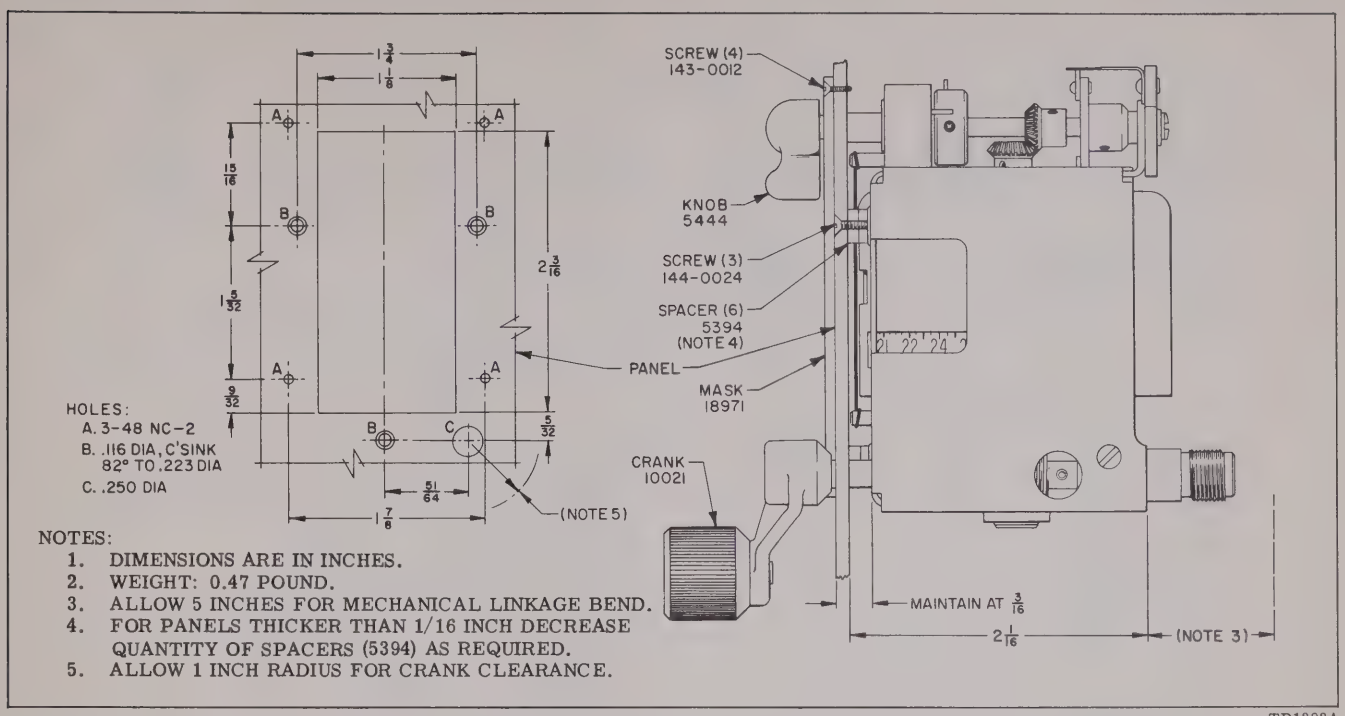
— A. WITHOUT ADAPTER PLATE —



— B. WITH ADAPTER PLATE —

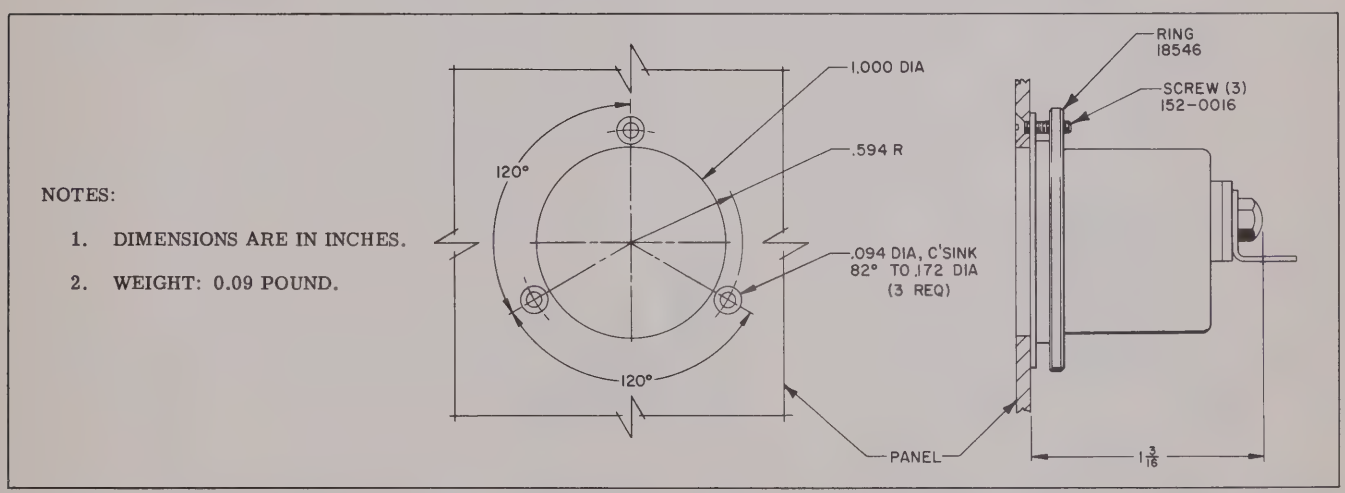
TP4343

Figure 2–5. CC-15A Control Unit, Assembly Details



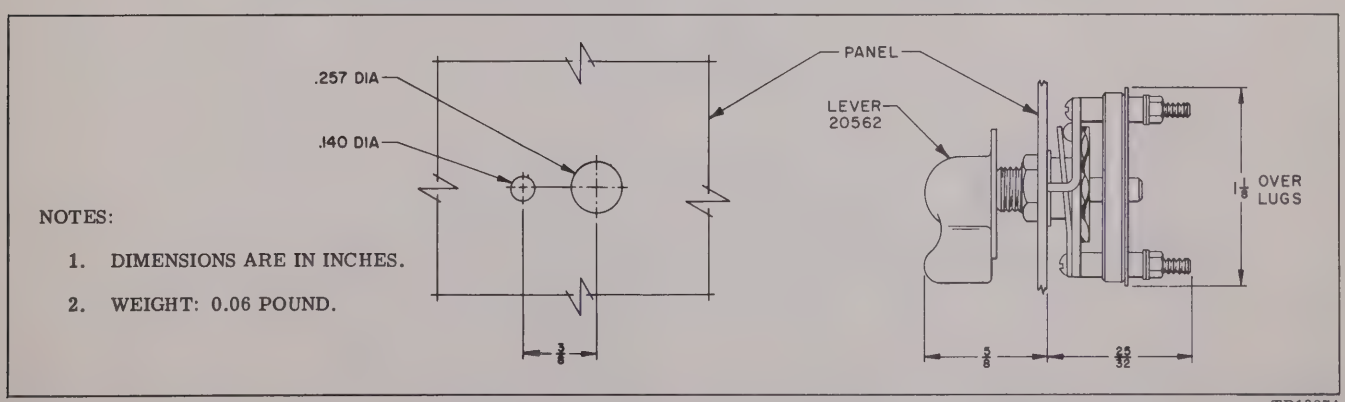
TP1393A

Figure 2–6. Dial Gearing Unit 18639, Installation Diagram



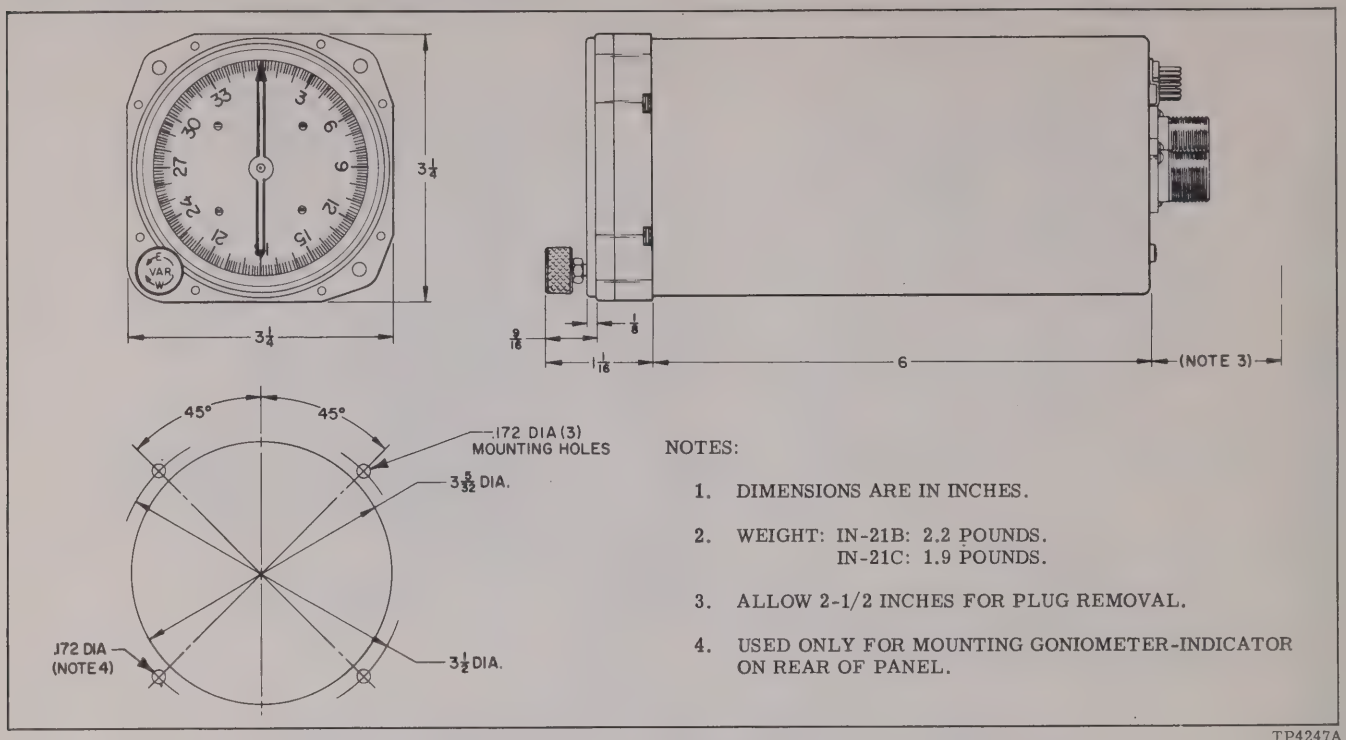
TP1395A

Figure 2–7. Tuning Meter 18428, Installation Diagram



TP1397A

Figure 2–8. Function Switch 19982, Installation Diagram

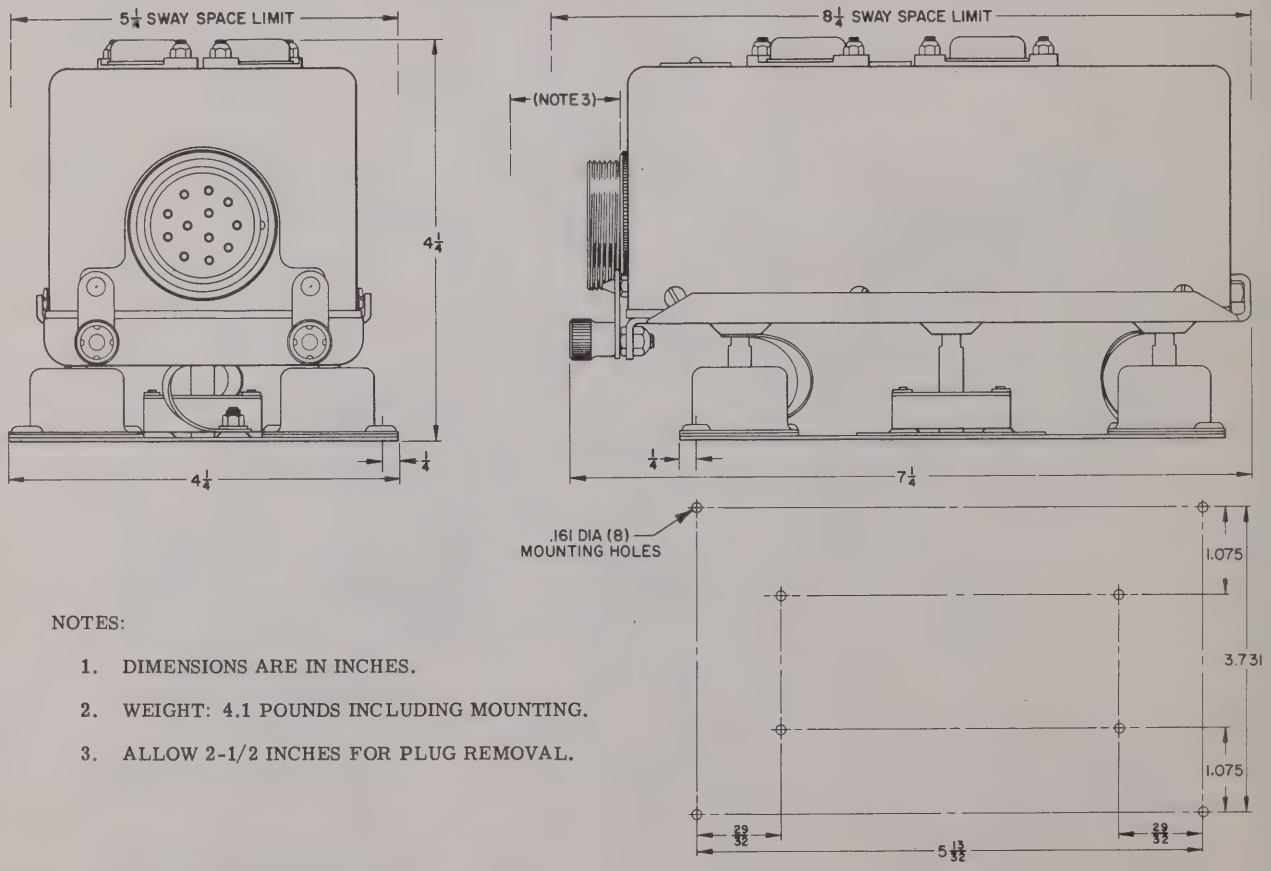


NOTES:

1. DIMENSIONS ARE IN INCHES.
2. WEIGHT: IN-21B: 2.2 POUNDS.
   IN-21C: 1.9 POUNDS.
3. ALLOW 2-1/2 INCHES FOR PLUG REMOVAL.
4. USED ONLY FOR MOUNTING GONIOMETER-INDICATOR ON REAR OF PANEL.

TP4247A

Figure 2–9. IN-21B and IN-21C Goniometer-Indicators, Installation Dimensions

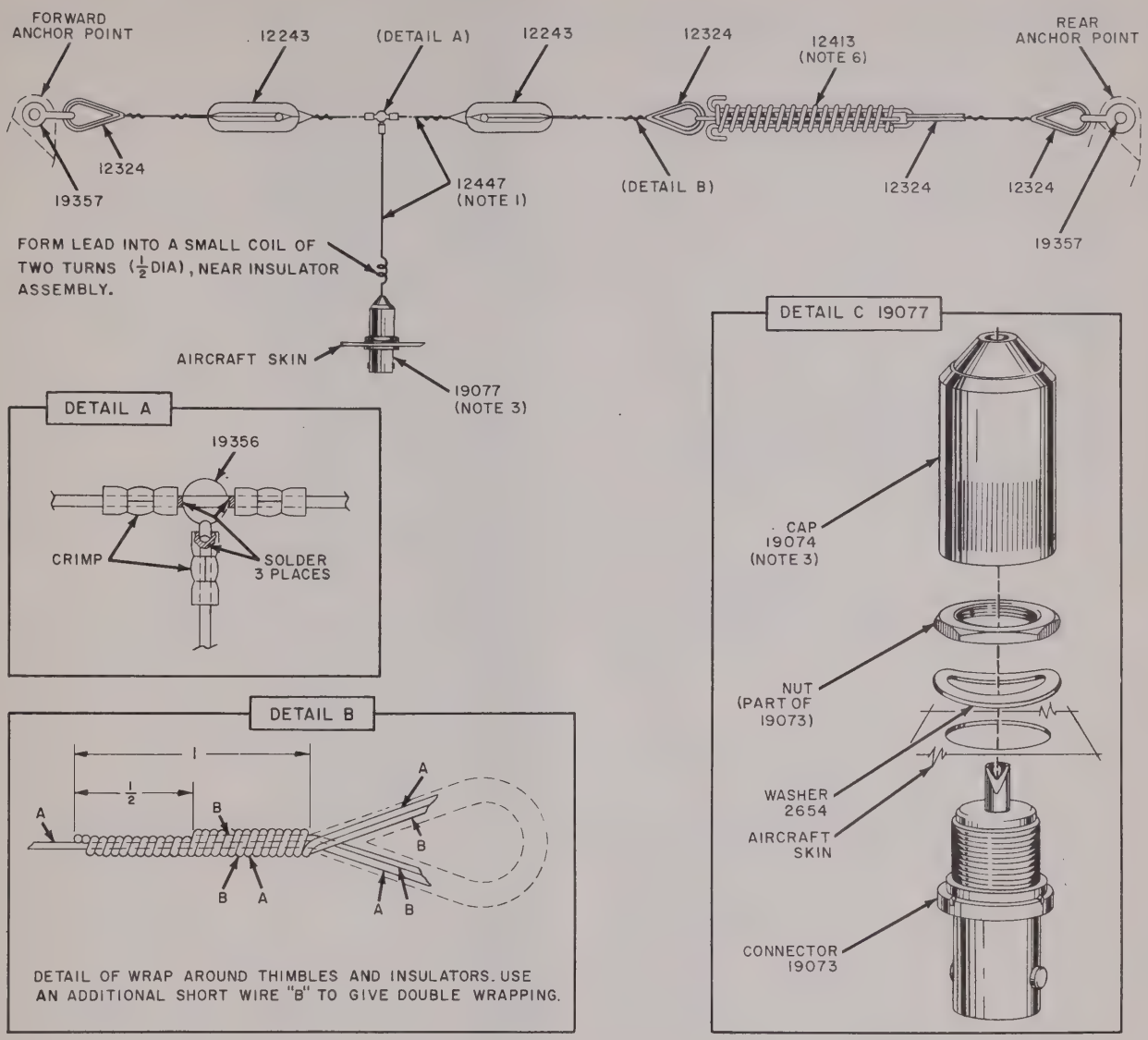


NOTES:

1. DIMENSIONS ARE IN INCHES.
2. WEIGHT: 4.1 POUNDS INCLUDING MOUNTING.
3. ALLOW 2-1/2 INCHES FOR PLUG REMOVAL.

TP2039A

Figure 2–10. DV-14A Dynaverter with M-28A Mounting, Installation Dimensions

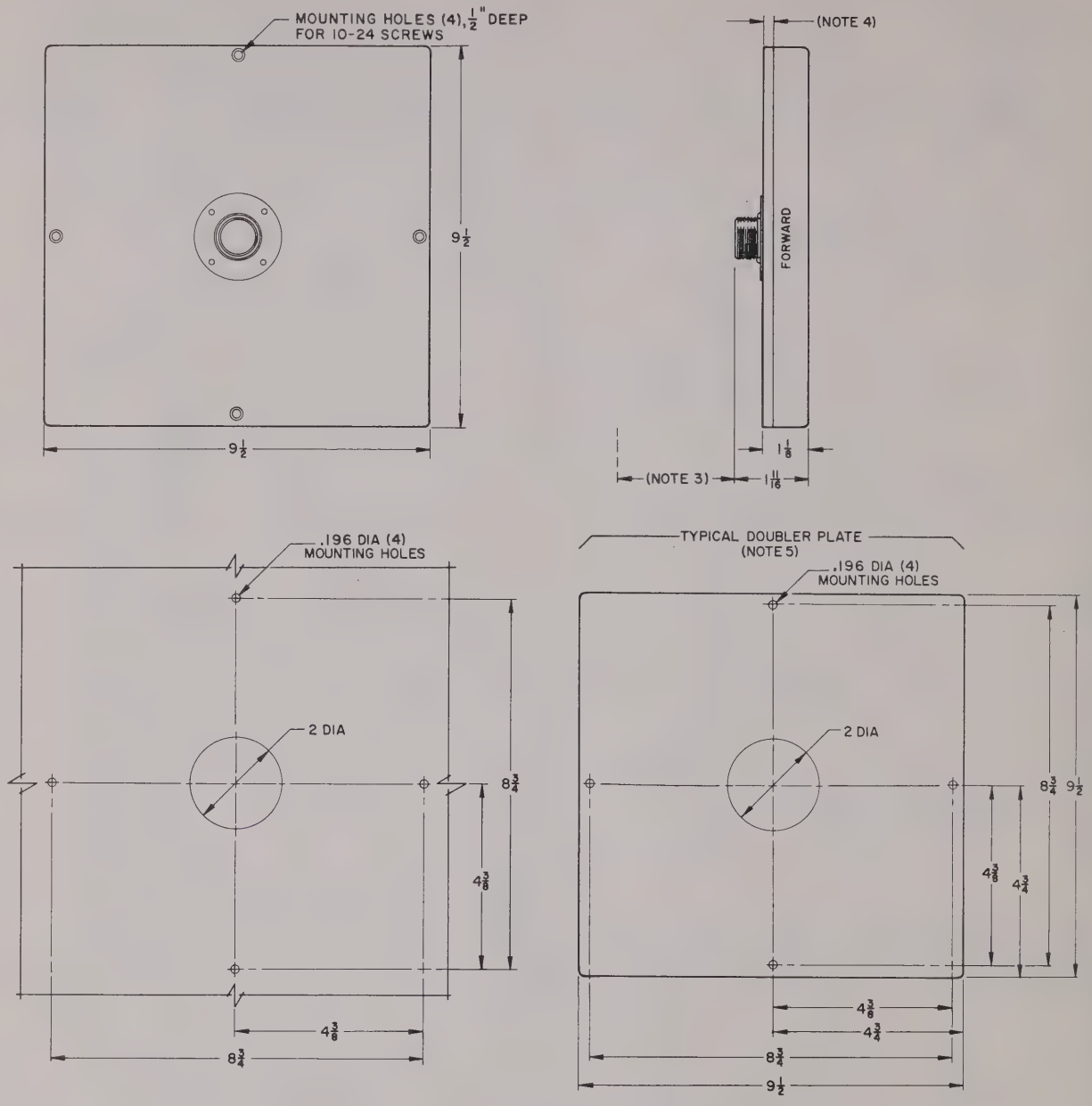


NOTES:

1. NOMINAL LENGTHS OF WIRE ARE FURNISHED WITH KIT. (ADDITIONAL WIRE MAY BE ORDERED SEPARATELY IN BULK.)
2. WIRES ARE NO. 18 AWG SOLID, COPPER-CLAD STEEL.
3. SEE DETAIL "C" FOR INSTALLATION OF INSULATOR ASSEMBLY. SCREW ON CAP AFTER SOLDERING.
4. USE SCREWS AND NUTS FURNISHED TO FASTEN ANTENNA MASTS TO AIRCRAFT.
5. LOCATE VERTICAL SECTION OF ANTENNA AS NEAR THE CENTER OF THE HORIZONTAL SECTION AS POSSIBLE.
6. ADJUST TENSION FOR 3/4-INCH SPRING DEFLECTION; THAT IS, WHEN COMPRESSED, COIL SPRING LENGTH IS 2-5/16 INCHES.

TP1411B

Figure 2–11. Sense Antenna Kit 19210, Installation Diagram



NOTES:

1. DIMENSIONS ARE IN INCHES.
2. WEIGHT: 4.4 POUNDS.
3. ALLOW 2 INCHES FOR CABLE CONNECTION AND REMOVAL.
4. 1/4 INCH NOMINAL; COMPRESSES TO 1/32 INCH.
5. USE 1/16 INCH ALUMINUM ALLOY.

TP4345

Figure 2–12. L-40B Loop Antenna, Installation Dimensions

NOTES:

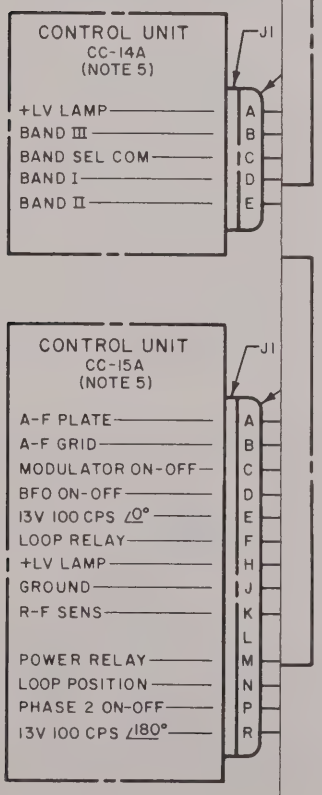
1. FOR PROPER MOUNTING, A
WHICH MOUNTINGS OR UNI
BE CLEAN, BARE METAL.
2. UNMARKED WIRES ARE NO
VINYLITE INSULATED. WIR
(*) ARE NO. 16 AWG STRAN
SULATED. SHIELDED WIRE
COPPER, VINYLITE INSULA
VINYLITE JACKET.
3. IN-21C IS NORMALLY SUPP
INDICATOR, SUCH AS IN-12
4. GONIOMETER-INDICATOR I
BOTTOM-MOUNTED LOOP
SENSE ANTENNA. IF OTHE
WIRE TERMINALS AS FOLL

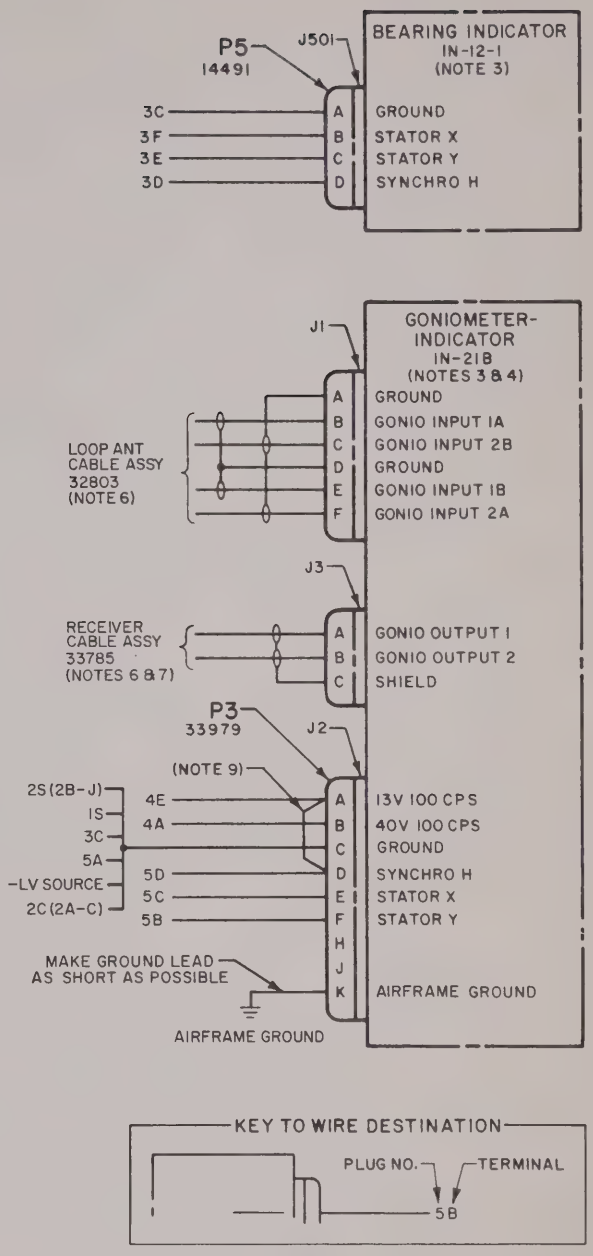
WIRE COLOR	TOP LOOP	
	TOP SENSE	BOTT SEN
RED	6	5
BLACK	5	6
GREEN	1	1
WHITE	2	2

5. C-59A IS NORMALLY SUPPI
AND CC-15A ARE SUBSTITU
SHOWN; THESE CONNECTI
WITHIN PARENTHESES AT
6. LENGTH OF CABLE ASSEM
ALTER.
7. RECEIVER CABLE ASSEMB
OF THREE CABLE LENGTH

PART NO.
33785-0010
33785-0020
33785-0030

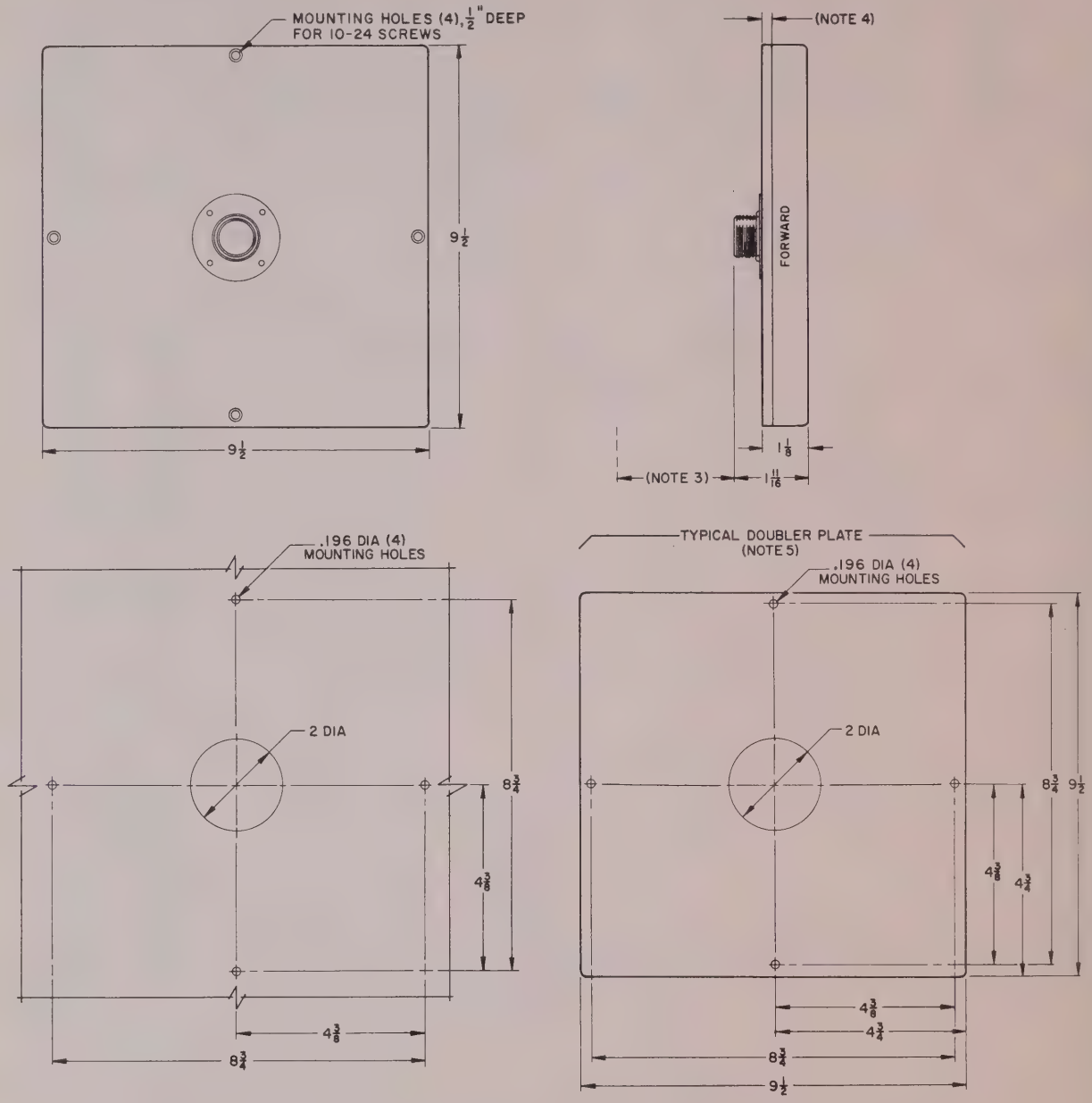
8. FOR 14-VOLT OPERATION,
THROUGH 5-AMPERE CIRC
OPERATION, CONNECT TO
AMPERE CIRCUIT BREAKE
9. FOR EXTERNAL EXCITATI
INDICATOR, REMOVE JUM
MINALS A AND D AND CON
VOLT, 400-CPS SOURCE.





TP4373

Figure 2–13. 21B Automatic Direction Finder, Interconnection Diagram



NOTES:

1. DIMENSIONS ARE IN INCHES.
2. WEIGHT: 4.4 POUNDS.
3. ALLOW 2 INCHES FOR CABLE CONNECTION AND REMOVAL.
4. 1/4 INCH NOMINAL; COMPRESSES TO 1/32 INCH.
5. USE 1/16 INCH ALUMINUM ALLOY.

TP4345

Figure 2–12. L-40B Loop Antenna, Installation Dimensions

NOTES:

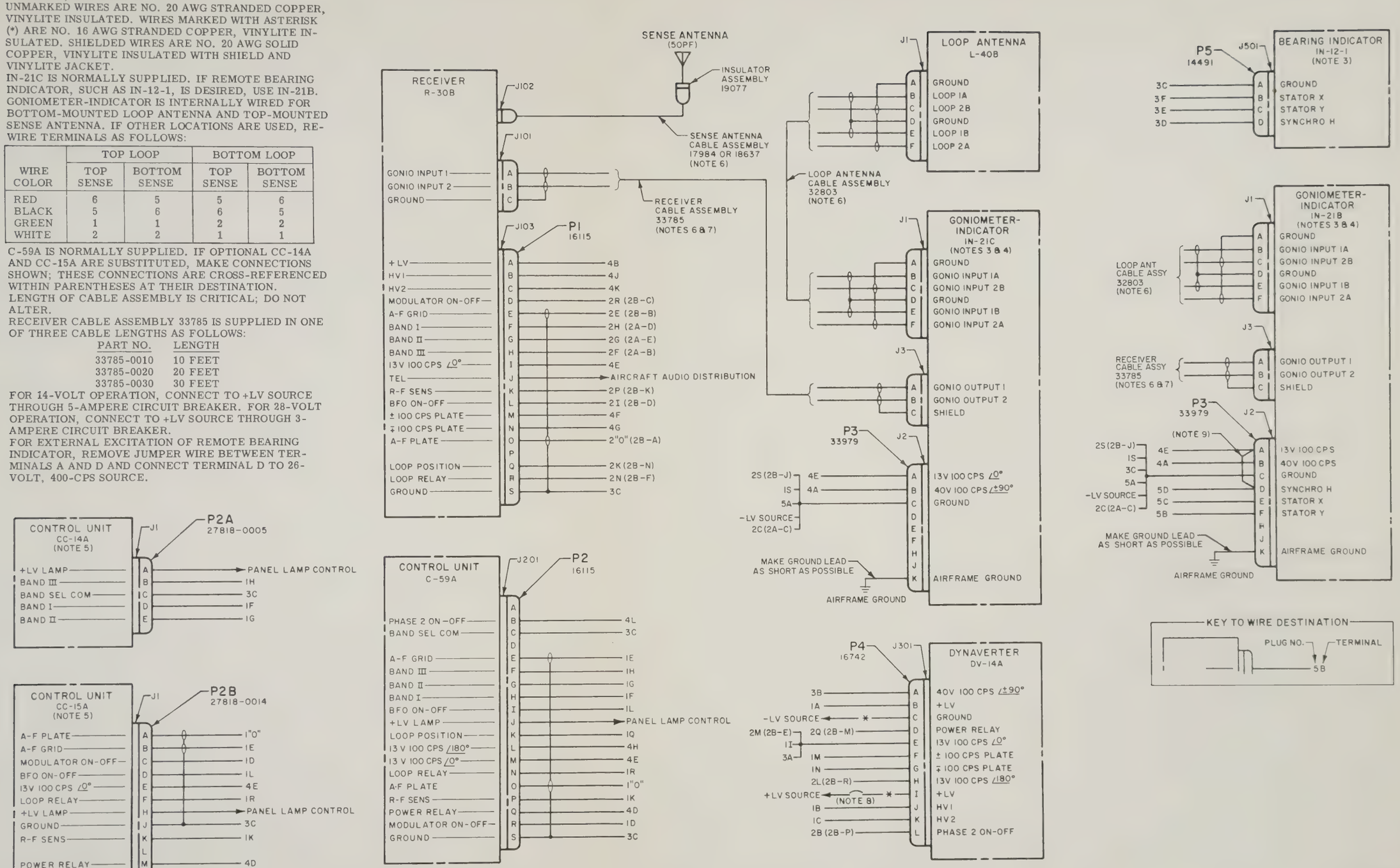
1. FOR PROPER MOUNTING, AIRCRAFT SURFACES TO, WHICH MOUNTINGS OR UNITS ARE ATTACHED MUST BE CLEAN, BARE METAL.
2. UNMARKED WIRES ARE NO. 20 AWG STRANDED COPPER, VINYLITE INSULATED. WIRES MARKED WITH ASTERISK (*) ARE NO. 16 AWG STRANDED COPPER, VINYLITE INSULATED. SHIELDED WIRES ARE NO. 20 AWG SOLID COPPER, VINYLITE INSULATED WITH SHIELD AND VINYLITE JACKET.
3. IN-21C IS NORMALLY SUPPLIED. IF REMOTE BEARING INDICATOR, SUCH AS IN-12-1, IS DESIRED, USE IN-21B.
4. GONIOMETER-INDICATOR IS INTERNALLY WIRED FOR BOTTOM-MOUNTED LOOP ANTENNA AND TOP-MOUNTED SENSE ANTENNA. IF OTHER LOCATIONS ARE USED, REWIRE TERMINALS AS FOLLOWS:

WIRE COLOR	TOP LOOP		BOTTOM LOOP	
	TOP SENSE	BOTTOM SENSE	TOP SENSE	BOTTOM SENSE
RED	6	5	5	6
BLACK	5	6	6	5
GREEN	1	1	2	2
WHITE	2	2	1	1

5. C-59A IS NORMALLY SUPPLIED. IF OPTIONAL CC-14A AND CC-15A ARE SUBSTITUTED, MAKE CONNECTIONS SHOWN; THESE CONNECTIONS ARE CROSS-REFERENCED WITHIN PARENTHESES AT THEIR DESTINATION.
6. LENGTH OF CABLE ASSEMBLY IS CRITICAL; DO NOT ALTER.
7. RECEIVER CABLE ASSEMBLY 33785 IS SUPPLIED IN ONE OF THREE CABLE LENGTHS AS FOLLOWS:

PART NO.	LENGTH
33785-0010	10 FEET
33785-0020	20 FEET
33785-0030	30 FEET

8. FOR 14-VOLT OPERATION, CONNECT TO +LV SOURCE THROUGH 5-AMPERE CIRCUIT BREAKER. FOR 28-VOLT OPERATION, CONNECT TO +LV SOURCE THROUGH 3-AMPERE CIRCUIT BREAKER.
9. FOR EXTERNAL EXCITATION OF REMOTE BEARING INDICATOR, REMOVE JUMPER WIRE BETWEEN TERMINALS A AND D AND CONNECT TERMINAL D TO 26-VOLT, 400-CPS SOURCE.



TP4373

Figure 2–13. 21B Automatic Direction Finder, Interconnection Diagram

2–10. LOOP COMPENSATION PROCEDURES.

Introduction. Due to the distortion of the radio field pattern caused by structural and electrical parts of the aircraft, the apparent direction of arrival of the radio signal must be checked every 15° with respect to the fore-and-aft axis of the aircraft. Provision is made to compensate for bearing errors produced by r-f field distortions, providing the errors do not exceed ±25°. A mechanical compensation device containing compensating screws is located in the rear of the goniometer-indicator as shown in Figure 2–14. When the adjustment screws are in their midpositions, there is 0° compensation. (Units are set for 0° compensation when delivered from the factory.)

To obtain accurate results, the loop antenna should be compensated twice: first, after gathering data on the ground; then, after gathering data in flight. The data, whether gathered on the ground or during flight, is used to prepare a compensation curve.

Note

Do not gather data during the period starting two hours before sunset and ending two hours after sunrise. Also, select a station that is static-clear and operating below 500 kc.

Obtaining Ground Data for Loop Compensation. To obtain ground data for loop compensation, proceed as follows:

Step 1. Position aircraft in an area clear of all objects which may cause distortions or reflections of received signal.

Step 2. Select a station having a known magnetic compass bearing. Using a compass or transit, align centerline of aircraft with magnetic bearing of station. Align 0° of dial at index on goniometer-indicator.

Step 3. If DG (directional gyro) is not slaved, set it to 0°. If DG is slaved, determine heading required to produce desired relative bearings.

Step 4. Turn aircraft clockwise through 360°, recording goniometer-indicator bearing indications every 15° on a form similar to that shown in Figure 2–15 (a completed form is shown in Figure 2–19).

Step 5. Repeat Step 4, turning aircraft counterclockwise through 360°.

Obtaining Flight Data for Loop Compensation. Two methods for obtaining flight data are described in the following paragraphs.

Method 1. The following procedure (see Figure 2–16) requires a fairly linear ground reference landmark, such as a road or railroad tracks, directed toward a clear-channel radio station at least 60 miles distant. Possible distortion of the radio field may be caused by certain structures such as power lines, steel towers, etc., on the route selected. To check whether such distortion exists, crisscross the reference line at various angles, while maintaining fixed courses by means of the DG. If rapid changes in the bearing are noted as the line is crossed, distortion exists. This distortion should be eliminated either by selecting another landmark or by flying at a higher altitude.

Note

The procedure in Steps 1 through 7 may be made over a single point, such as a radio intersection, providing the bearing to the radio station is known. Fly a series of figure eights, always crossing the reference point on a 15° change in heading from the previous course. Record the goniometer-indicator bearing each time the aircraft crosses the reference point.

Step 1. With aircraft in level flight headed toward radio station, fly reference line at an altitude low enough for accurate determination of position and direction. Set DG to 0° if DG is not slaved. (If aircraft has a slaved gyro, determine heading required to produce desired relative bearings.) Turn VAR. knob to align dial 0° position with index at top of goniometer-indicator. Turn aircraft to a 0° heading. Record relative bearing read on goniometer-indicator on a form similar to that shown in Figure 2–15 (a completed form is shown in Figure 2–19).

Step 2. Fly a sufficient distance from reference line so that it may be crossed at a heading of 15°. With aircraft held in level flight on a heading of 15°, record relative bearing read on goniometer-indicator when reference line is crossed.

Step 3. Fly sufficiently past reference line so that line may be recrossed at a heading of 345° with aircraft in level flight (see Figure 2–16). Record goniometer-indicator bearing when aircraft crosses reference line.

Step 4. Repeat Steps 2 and 3 for headings of 30° and 330°.

Step 5. Turn aircraft to a heading of 180° from radio station and check DG reading when heading of aircraft coincides with reference line. DG reading should be within approximately 2° of a 180° heading if all maneuvers have been made properly. If precession of DG is noted when 180° reference line course is checked, repeat procedure, or check DG. Normal creeping of a free DG (2° or less over a period of 15 minutes) may be proportioned to each heading.

Step 6. With aircraft on a 180° heading away from radio station, follow a procedure similar to that outlined previously and obtain goniometer-indicator bearings for headings of 190°, 165°, 210°, and 150° (see Figure 2–16). Then, turn aircraft to head toward radio station along reference line, establishing a 0° heading with respect to reference line.

Step 7. Continue to fly to and from radio station, crisscrossing reference line, as shown in Figure 2–16, until goniometer-indicator bearings for every 15° change in heading of aircraft have been recorded. Recorded data will be used for compensation.

Method 2. The following procedure requires making two 360° flight turns in opposing directions, some distance from a radio station. A landmark, such as a crossroad or a building, is used for a ground reference point from which each circle is started. Disregarding errors introduced by flight conditions or observation procedures, the accuracy of this procedure depends on the distance of the reference point from the radio station and the diameter of the two circles. The ground reference point should be as far as possible from the radio station, but still at a distance where reliable bearing indications can be obtained. The diameter of each circle should be nearly equal so that the error angles at corresponding angles of the turn circles cancel when averaged. The diameters should also be as small as possible, yet large enough so that the flying time during each chord of the circle is sufficient to permit obtaining a reliable reading. As a general recommendation, it is suggested that the distance between the ground reference point and the radio station be at least 60 miles, and that each circle have a maximum diameter of 9 miles.

Before the actual flight procedure is begun, it is necessary to correlate the 0° bearing of the goniometer-indicator with the 0° heading of the aircraft. Proceed as follows:

Step 1. Head aircraft directly toward a radio station whose transmitting tower is clearly visible.

Step 2. Tune receiver to station frequency. Adjust VAR. knob to align dial 0° position with index at top of goniometer-indicator.

Step 3. Using a cross-hair sight which has been aligned accurately with fore-and-aft axis of aircraft, align axis of aircraft with station antenna tower as accurately as possible. If a cross-hair sight is not available, aircraft heading and tower may be aligned by an observer standing as far aft as possible, with a clear line-of-sight through vertical center of windshield, and sighting along centerline of aircraft through center of windshield. Heading checks made directly from cockpit are not reliable because parallax errors may result.

Step 4. With aircraft held in level flight, and headed directly toward station tower, note goniometer-indicator bearing. To confirm reading obtained, approach station tower from opposite direction and check that goniometer-indicator bearing is the same. Record goniometer-indicator bearing obtained for 0° heading of aircraft.

With the 0° goniometer-indicator bearing and the 0° aircraft heading correlated, the flight procedure may be performed (see Figure 2–17). The principle of this procedure is to obtain indicator readings for every 15° change in heading during each of the 360° turns. To approximate a circle as closely as possible, the flying time and speed of each 15° course should be very nearly equal. After each turn has been completed, a goniometer-indicator reading relative to a given DG reading will be obtained for each turn. The goniometer-indicator readings are averaged and the result is used for loop compensation. Proceed as follows:

Step 1. Select a ground reference point which is not less than 60 miles from radio station to be used. Approach reference point so that it is between aircraft and station. Orient aircraft for a 0° bearing on goniometer-indicator. If previous flight procedure has established that 0° heading of aircraft does not coincide with 0° bearing of station within ±2°, fly aircraft on heading that corresponds to 0° bearing obtained in preliminary flight procedure.

Step 2. With aircraft held in steady, level flight directly toward station, set DG to 0°. (If a slaved DG is installed in the aircraft, determine the proper heading.) Maintain heading, and when aircraft is over ground reference point, record goniometer-indicator bearing.

Step 3. Turn aircraft smoothly and evenly to right for a heading of 15°. With aircraft leveled out on this heading for not more than 25 seconds, note and record goniometer-indicator bearing on a form similar to that shown in Figure 2–15.

Step 4. Turn aircraft to a heading of 30°. After level flight has been reassumed, note and record goniometer-indicator bearing.

Step 5. Follow a similar procedure as outlined previously in Steps 3 and 4 for each 15° increase in heading of aircraft, until circle-turn is completed. Record goniometer-indicator bearings for each heading. If turn has been executed properly, aircraft should be over reference point at end of last 15° turn. Turn aircraft for a 0° goniometer-indicator bearing. Aircraft should now be headed directly toward radio station in line with original starting line. Check relative bearing for this heading; reading should agree with its original setting within 2° to 3° if all turns have been made properly.

Step 6. With aircraft over ground reference point and headed directly toward station, as shown by goniometer-indicator reading, check that DG reading agrees with its original setting. If not, make a 0° reference check, as outlined in Steps 1 and 2 of this procedure.

Step 7. Start second 360° turn by turning the aircraft to left for a 345° heading. When aircraft is in steady, level flight on this heading, record goniometer-indicator bearing.

Step 8. Continue circle turn, until completed, decreasing heading in 15° intervals. Keep diameter of this left

turn as equivalent as possible to right turn made previously. Record goniometer-indicator bearing for each 15° change in heading.

Step 9. Average right-turn and left-turn goniometer-indicator bearings for each corresponding DG heading. Recorded averages will be used for compensation.

Preparation of Compensation Data Curve. After the in-flight compensation data has been recorded, the data may be plotted and the resulting curve used for determining the compensation adjustments. Proceed as follows:

Step 1. Using a form similar to that shown in Figure 2–18, lay a straight edge parallel to sloping dotted line and through data point of column 3 on horizontal scale, and draw a fine line (see Figure 2–19). Point at which this line intersects solid line is plot point. (The example shown in Figure 2–19 indicates that for an actual bearing of 15°, the goniometer-indicator bearing is 30°.)

Step 2. Repeat Step 1 for each of remaining 15° positions.

Step 3. Connect plotted points to form compensation data curve.

Step 4. Determine corrected goniometer-indicator bearing values for column 5 of Figure 2–15 (see Figure 2–19 for example) from resulting curve as follows:

a. Draw fine lines parallel to solid lines at intersections of plotted curve and dotted lines corresponding to degree values given in column 4 of Figure 2–15.

b. In column 5 of Figure 2–15, record values for points of intersection as read on horizontal graduations beside 15° dotted line values in column 4 of Figure 2–15. For example: To determine corrected goniometer-indicator bearing of 45° (column 4), lay straight edge parallel to solid line and draw a fine line through intersection of dotted 45° line and curve (see Figure 2–19). This line passes through horizontal graduations at 63°. This value is recorded in column 5. Similarly, a bearing of 105° from column 4 gives a bearing of 100° for column 5.

Goniometer-Indicator Adjustment Procedure. To compensate the goniometer-indicator, proceed as follows:

Step 1. Disconnect cables from goniometer-indicator and remove indicator from instrument panel.

Note

Compensation can be performed without power applied to the goniometer-indicator.

Step 2. Remove dust cover from goniometer-indicator. Remove screw on rear plate and swing down hinged rear plate (see Figure 2–14).

Step 3. Align 0° on dial with index on front of goniometer-indicator using VAR. knob.

Step 4. Using goniometer drive gear (see Figure 2–14), align 0° mark on goniometer drum dial (see Figure 2–14) with fiducial. Hold goniometer-indicator so that all gears rotate freely.

Step 5. Adjust 0° compensation screw until goniometer-indicator pointer indicates computed value for 0° in column 5 of Figure 2–15.

CAUTION

Do not force screws. In the following procedure, it may appear at first that the compensation available at a particular point is insufficient to make the indicator read correctly. If this occurs, *do not force the screw* in question but proceed to set the other screws. When, as required by Step 8, the adjustment procedure is repeated, it will be found that sufficient compensation is available from all adjustment points.

Step 6. Align 15° mark on goniometer dial with fiducial using goniometer drive gear (see Figure 2–14). Adjust 15° compensation screw until goniometer-indicator pointer indicates computed value for 15° in column 5 of Figure 2–15.

Step 7. Continue adjustment for each screw using computed value in column 5 of Figure 2–15 for screw being adjusted.

Step 8. Repeat Steps 4 through 7 until satisfactory compensation has been achieved.

Step 9. Reassemble and reinstall goniometer-indicator.

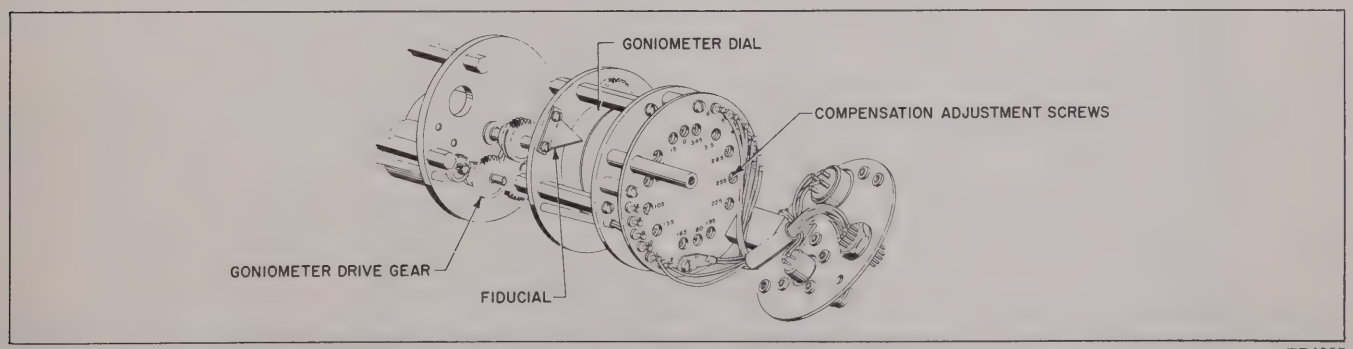


Figure 2–14. Goniometer-Indicator, Compensation Adjustment Points

FLIGHT DATA FOR LOOP COMPENSATION

Station Used _____ Frequency _____

Pilot _____ Recorder _____

Reference Point _____ Date _____

Aircraft Type _____ Aircraft No. _____

FLIGHT DATA			LOOP COMPENSATION DATA	
Column 1	Column 2	Column 3	Column 4	Column 5
Aircraft Relative Heading	Station Relative Bearing	Goniometer-Indicator Reading	Goniometer-Indicator Dial Reading	Compensated Goniometer-Indicator Reading
0	360		0	
15	345		345	
30	330		—	
45	315		315	
60	300		—	
75	285		285	
90	270		—	
105	255		255	
120	240		—	
135	225		225	
150	210		—	
165	195		195	
180	180		180	
195	165		165	
210	150		—	
225	135		135	
240	120		—	
255	105		105	
270	90		—	
285	75		75	
300	60		—	
315	45		45	
330	30		—	
345	15		15	
360	0		0	

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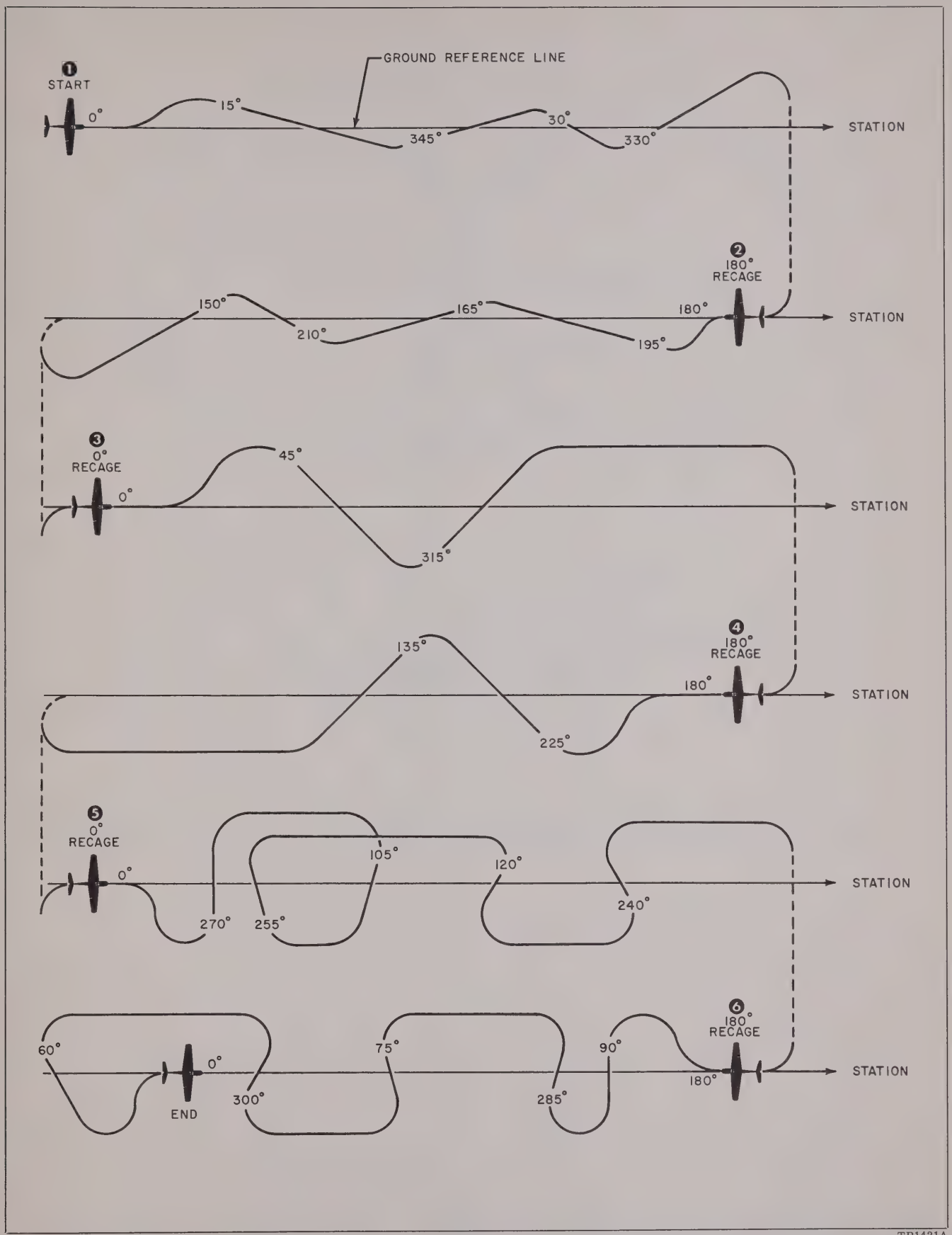
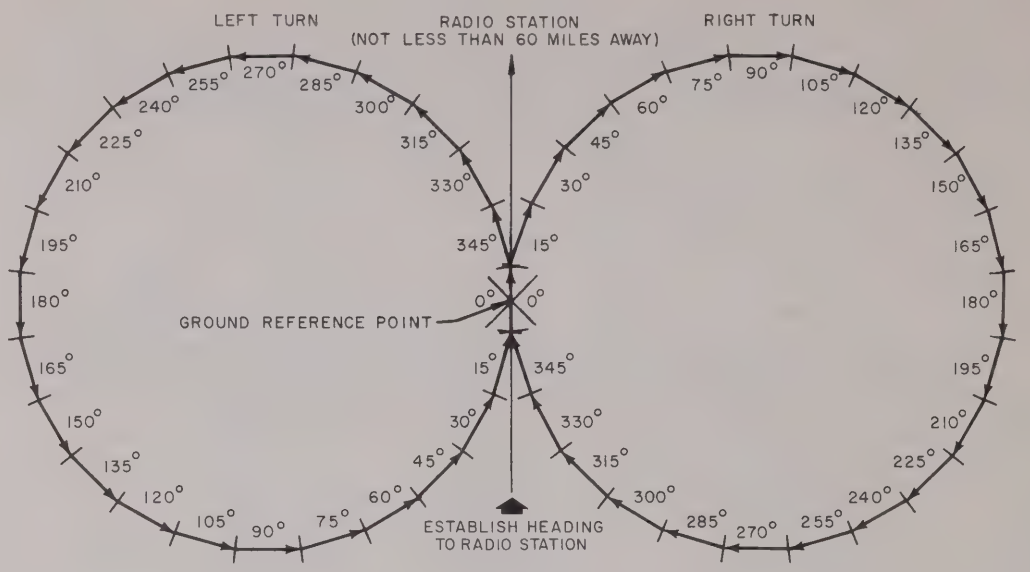
Figure 2–15. Form for Recording Flight Data for Loop Compensation



TP1421A

Figure 2–16. Procedure for Obtaining Flight Data for Loop Compensation, Flying Ground Reference Line

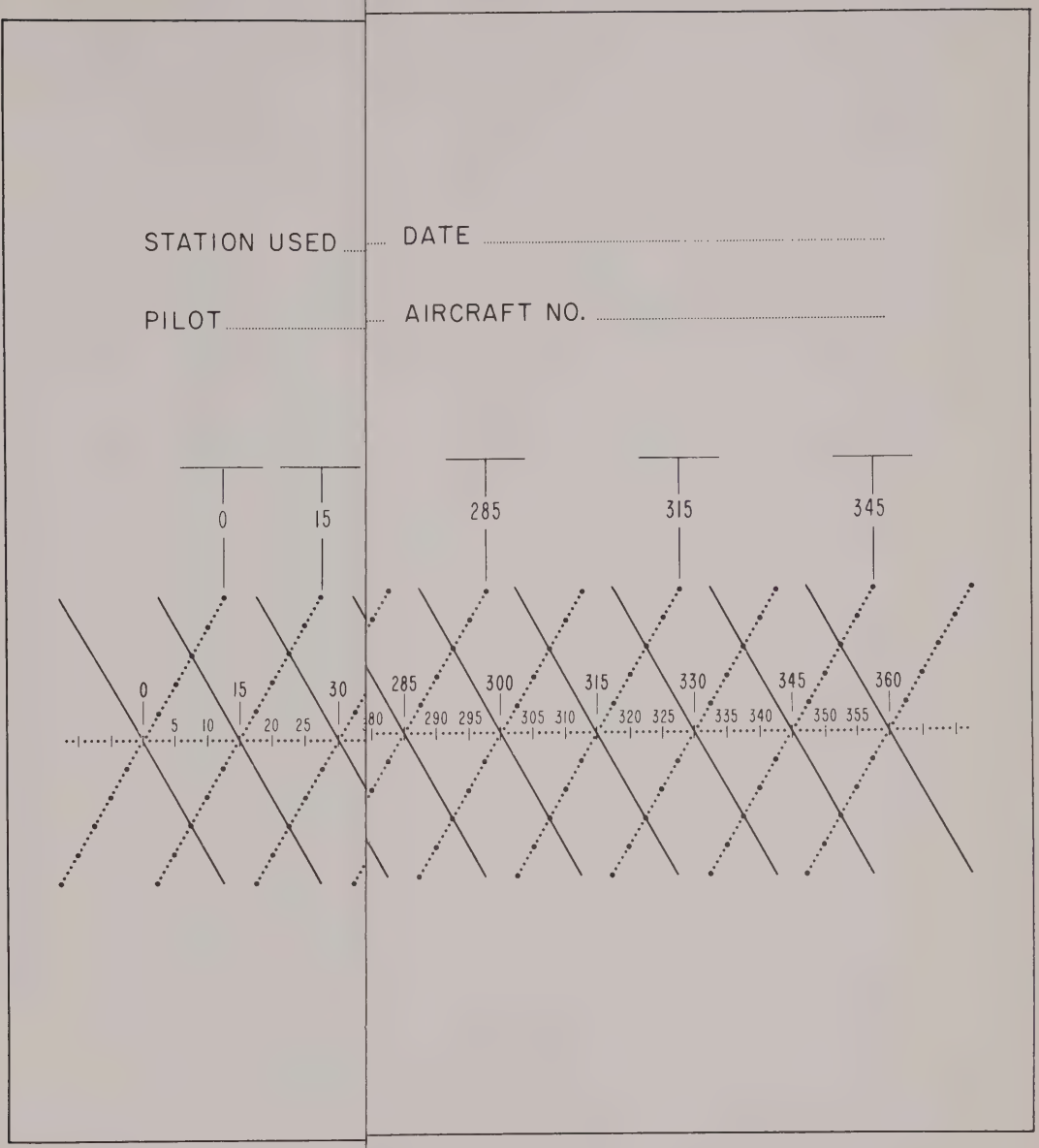


PROCEDURE:

1. ESTABLISH HEADING.
2. READ INDICATOR BEARING.
3. CHANGE DG HEADING 15 DEGREES AND REPEAT. (ALLOW EQUIVALENT TIME FOR EACH HEADING SO THAT DIAMETERS OF TURNS ARE EQUAL.)

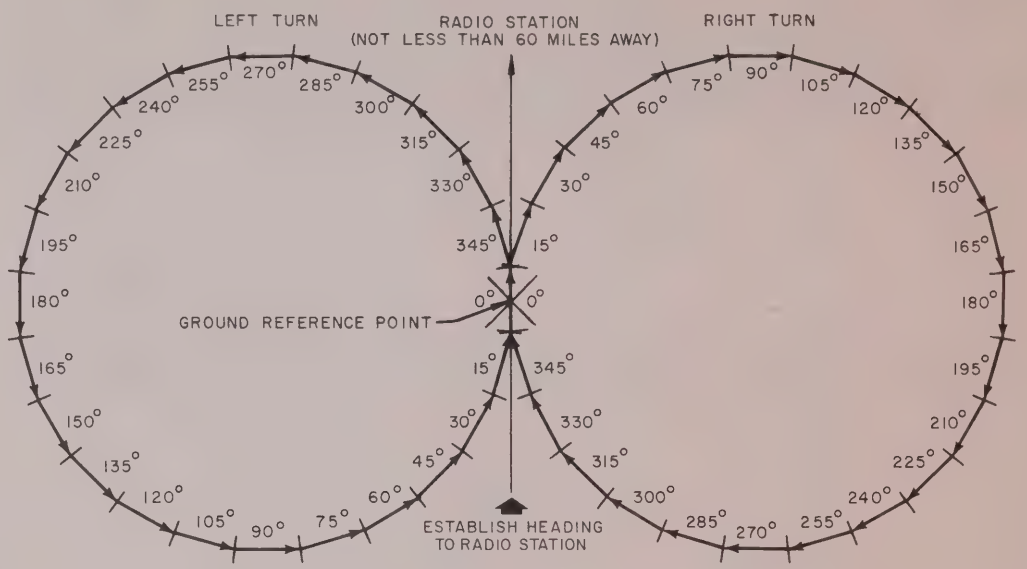
TP1427A

Figure 2–17. Procedure for Obtaining Flight Data for Loop Compensation, Flying Two 360° Turns



TP4261

Figure 2–18. Form for Plotting Loop Compensation Data Curve



PROCEDURE:

1. ESTABLISH HEADING.
2. READ INDICATOR BEARING.
3. CHANGE DG HEADING 15 DEGREES AND REPEAT. (ALLOW EQUIVALENT TIME FOR EACH HEADING SO THAT DIAMETERS OF TURNS ARE EQUAL.)

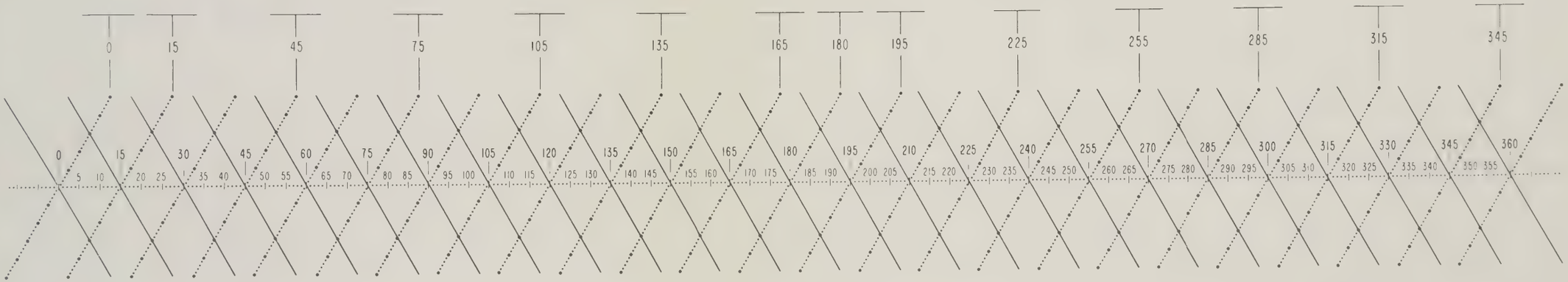
TP1427A

Figure 2–17. Procedure for Obtaining Flight Data for Loop Compensation, Flying Two 360° Turns

LOOP COMPENSATION DATA CURVE

STATION USED ..... FREQUENCY ..... REF POINT ..... DATE .....

PILOT ..... RECORDER ..... AIRCRAFT TYPE ..... AIRCRAFT NO. .....



TP4261

Figure 2–18. Form for Plotting Loop Compensation Data Curve

FLIGHT DATA FOR L

Station Used ABC

Pilot L.H. NAUMANN

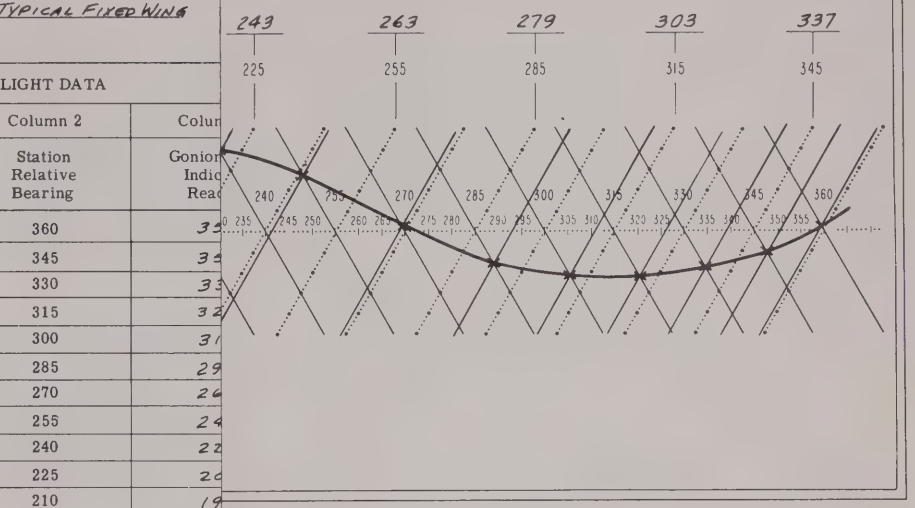
Reference Point ARC AIRFIELD

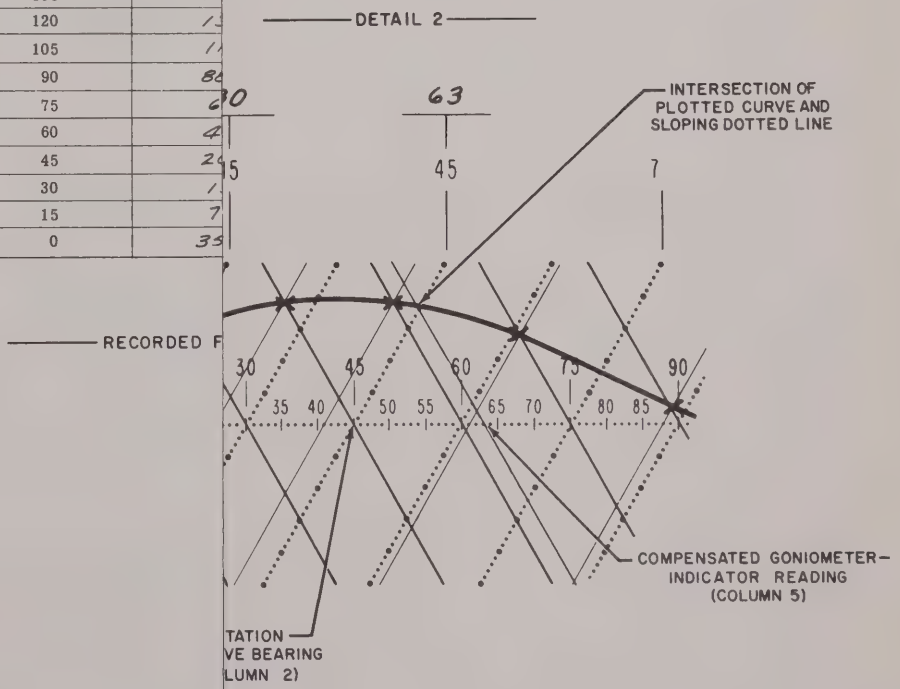
Aircraft Type TYPICAL FIXED WING

FIELD ..... DATE NOVEMBER 2, 1964

AL FIXED WING AIRCRAFT NO. N12345

FLIGHT DATA		
Column 1	Column 2	Colur
Aircraft Relative Heading	Station Relative Bearing	Gonior Indic Read
0	360	35
15	345	3
30	330	3
45	315	32
60	300	31
75	285	29
90	270	2
105	255	2
120	240	2
135	225	2
150	210	19
165	195	18
180	180	17
195	165	16
210	150	1
225	135	1
240	120	1
255	105	1
270	90	8
285	75	6
300	60	4
315	45	2
330	30	1
345	15	7
360	0	35





TP4263

Figure 2–19. Example of Recorded Flight Data and Loop Compensation Curve

FLIGHT DATA FOR LOOP COMPENSATION

Station Used ABC — Frequency 330 KC
Pilot L.H. NAUMANN — Recorder F.E. KLENA
Reference Point ARC AIRFIELD — Date NOVEMBER 2, 1964
Aircraft Type TYPICAL FIXED WING — Aircraft No. N12345

FLIGHT DATA			LOOP COMPENSATION DATA	
Column 1	Column 2	Column 3	Column 4	Column 5
Aircraft Relative Heading	Station Relative Bearing	Goniometer-Indicator Reading	Goniometer-Indicator Dial Reading	Compensated Goniometer-Indicator Reading
0	360	359	0	1
15	345	350	345	337
30	330	339	—	—
45	315	326	315	303
60	300	311	—	—
75	285	293	285	279
90	270	269	—	—
105	255	241	255	263
120	240	220	—	—
135	225	205	225	243
150	210	195	—	—
165	195	186	195	210
180	180	179	180	181
195	165	169	165	159
210	150	158	—	—
225	135	146	135	123
240	120	131	—	—
255	105	112	105	100
270	90	88	—	—
285	75	61	75	83
300	60	41	—	—
315	45	26	45	63
330	30	15	—	—
345	15	7	15	30
360	0	359	0	1

RECORDED FLIGHT DATA

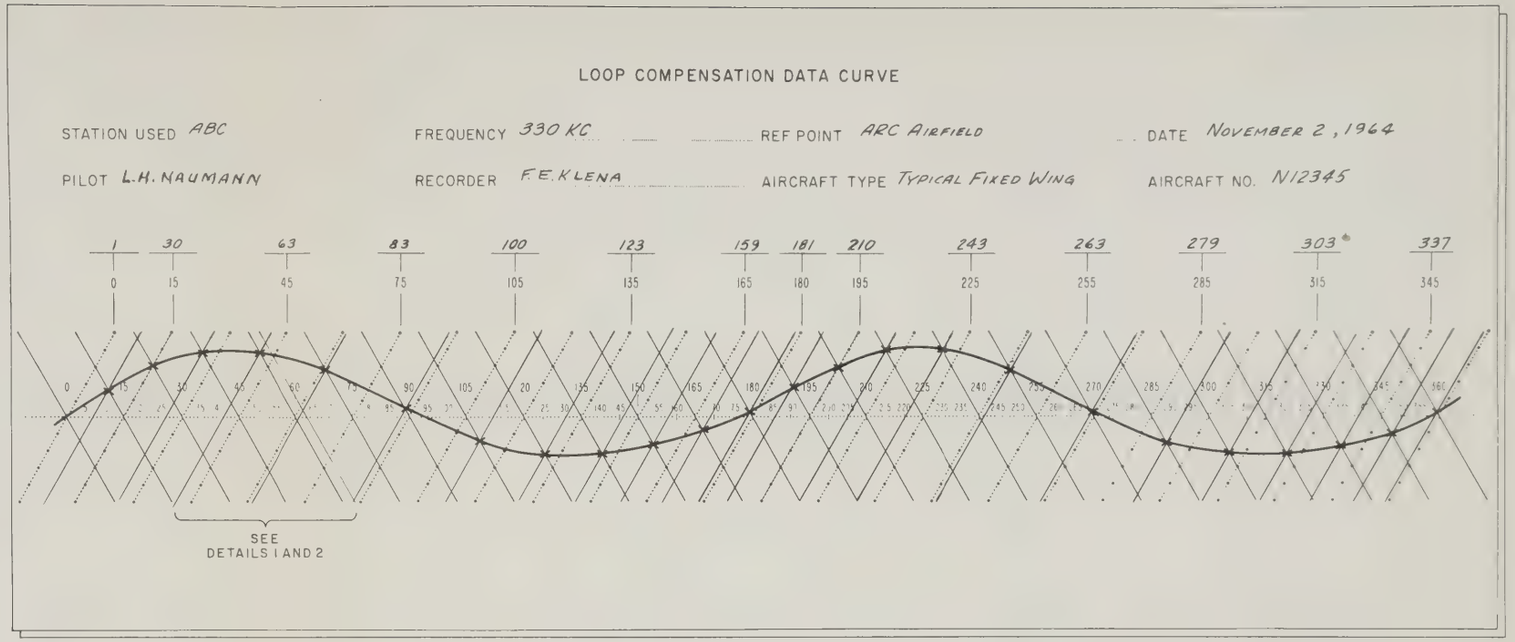

LOOP COMPENSATION DATA CURVE
STATION USED ABC
FREQUENCY 330 KC
REF POINT ARC AIRFIELD
DATE NOVEMBER 2, 1964
PILOT L.H. NAUMANN
RECORDER F.E. KLENA
AIRCRAFT TYPE TYPICAL FIXED WING
AIRCRAFT NO. N12345
1 30 63 83 100 123 159 181 210 243 263 279 303 337
0 15 45 75 105 135 165 180 195 225 255 285 315 345
SEE DETAILS 1 AND 2
PLOTTED COMPENSATION CURVE
DETAIL 1
30 63
15 45 7
TYPICAL PLOT POINT
FINE LINE
15 30 45 60 75 90
20 25 35 40 50 55 65 70 80 85
GONIOMETER—INDICATOR READING (COLUMN 3)
STATION RELATIVE BEARING (COLUMN 2)
DETAIL 2
30 63
15 45 7
INTERSECTION OF PLOTTED CURVE AND SLOPING DOTTED LINE
15 30 45 60 75 90
20 25 35 40 50 55 65 70 80 85
COMPENSATED GONIOMETER—INDICATOR READING (COLUMN 5)
STATION RELATIVE BEARING (COLUMN 2)
TP4263

Figure 2–19. Example of Recorded Flight Data and Loop Compensation Curve

SECTION III
OPERATION

3–1. INTRODUCTION.

This section describes the operating controls and indicators and outlines the general procedure for operating the ADF set. Detailed operating procedures are described and illustrated in the pilot's manual.

3–2. OPERATING CONTROLS AND INDICATORS.

All operating controls and indicators for the ADF set are located on the front panel of the control unit and goniometer-indicator, as shown in Figure 3–1. Table 3–1 lists the designations and describes the functions of the controls and indicators.

3–3. GENERAL OPERATING PROCEDURE.

Step 1. Rotate control unit VOL control clockwise to turn on ADF set and allow 30 seconds for equipment to warm up.

Step 2. Set function switch to ANT.

Step 3. Set MC BAND switch to desired frequency band.

Step 4. Adjust VOL control until background noise (or station if already tuned in) is heard.

Step 5. Rotate tuning crank until station frequency is aligned with frequency dial hairline, then tune for maximum tuning meter deflection by slowly adjusting tuning crank in vicinity of desired frequency.

Step 6. Readjust VOL control to desired audio level. Identify station.

Step 7. Set function switch to position required for desired function:

a. To use as automatic direction finder, set function switch to COMP and readjust tuning crank for maximum deflection on tuning meter.

b. To use as low-frequency communication receiver, set function switch to ANT and readjust tuning crank for best aural reception.

c. To use as manual direction finder (aural null procedure) set function switch to LOOP and readjust tuning crank for best aural reception.

3–4. BFO OPERATION.

General. The BFO is used to identify keyed CW transmissions within the frequency range of the receiver, such as those employed in areas outside the U.S.A., and to aid in determining aural nulls. For CW identification, the function switch is placed in the ANT position; for aural null procedures, the switch is set to the LOOP position.

CW Signals. The BFO is used principally for the identification of keyed CW signals. When the BFO is operating, a small voltage is injected into the i-f amplifier of the receiver to produce a 900-cycle beat note with a properly tuned CW signal. This beat note (tone) appears in the audio output of the receiver. As the receiver is detuned slightly, the frequency of the beat note will change producing a different tone as heard in the headset. As the receiver is tuned from one side of the signal to the other, the tone will decrease from a high pitch to zero and then increase again on the other side of the zero beat. Thus, there are two receiver tunings which produce a 900-cycle tone, only one of which may be used for correct operation. Consequently, when using the BFO, tune to the lower of the two closely adjacent dial readings at which a suitable tone is obtained.

Modulated Signals. If the BFO is turned on when a tone-modulated signal is being received, output tones will be heard at the beat frequencies between the BFO and the modulation side-bands, as well as the beat frequency with the carrier. Therefore, to avoid confusion, the BFO should not be used when receiving a tone-modulated carrier.

If the BFO is turned on with the function switch in the COMP position, a beat note will be heard which is relatively weak when compared to that which can be obtained in the ANT position. This relative weakness is due to the avc action and the method of controlling the audio gain in the COMP position. Under this condition, the signal level is so high at the end of the i-f amplifier that the BFO produces only a very small percentage modulation of the i-f signal. Consequently, never use the BFO with the COMP position; check the deflection of the tuning meter when tuning the receiver.

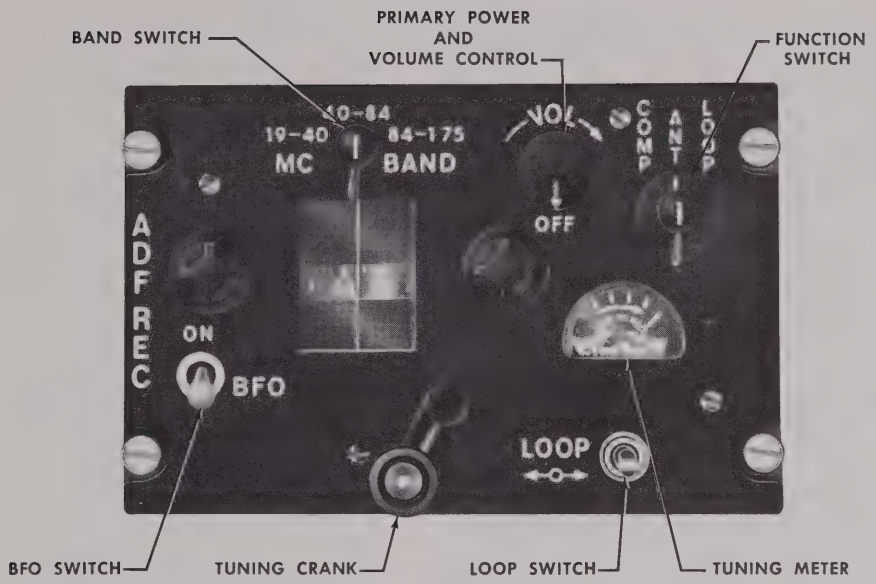
TABLE 3–1. OPERATING CONTROLS AND INDICATORS

Designation	*Control or Indicator*	*Function*
	CONTROL UNIT	
VOL	Primary Power and Volume Control	Combined primary power and volume control. Initial clockwise rotation applies primary power to ADF set. With function switch in COMP position, further rotation controls audio level; in ANT or LOOP position, further rotation controls r-f sensitivity.
—	Function Switch	COMP: Set operates as automatic direction finder using loop and sense antennas. ANT: Set operates as communication receiver using sense antenna only. LOOP: Set operates as manual direction finder using loop antenna only.
BFO	BFO Switch	Controls beat frequency oscillator in receiver for identification of keyed CW transmissions.
MC BAND	Band Switch	Selects desired frequency band.
—	Tuning Crank	Selects desired frequency within selected frequency band.
—	Tuning Meter	With function switch in COMP position, maximum deflection indicates accurate tuning.
LOOP	Loop Switch	Rotates goniometer rotor. With switch in LOOP position, positions rotor as desired for MDF operation; in COMP position, tests operation and signal reliability.
	GONIOMETER-INDICATOR	
VAR.	Variation Control	Rotates dial to introduce relative, magnetic, or true bearing information.
—	Index	When VAR. control is adjusted, indicates relative, magnetic, or true heading of aircraft.
—	Pointer	When VAR. control is adjusted, indicates relative, magnetic, or true bearing from which radio signal is being received.

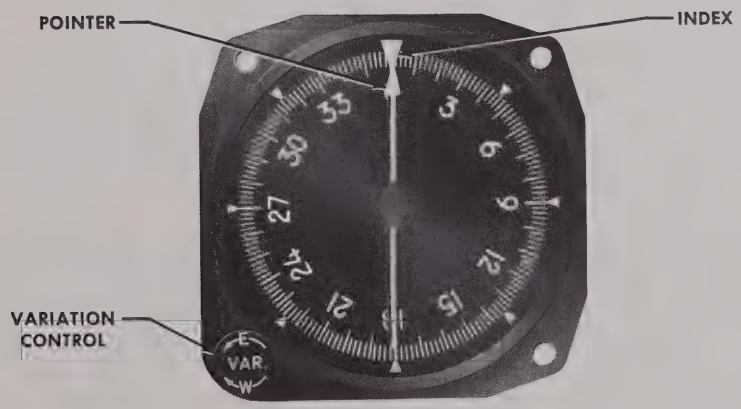
Loop Operation with BFO. With unmodulated, or voice- or music-modulated signals, the BFO can be used to produce a steady single-frequency beat note with the carrier. When the goniometer rotor is rotated, this tone will change in amplitude, going sharply to zero at each null position so that an aural null may be defined quite readily. For this application, with the function switch in the LOOP position, tune the receiver to obtain a beat note of the desired audio frequency, with the dial turned toward the frequencies below the zero beat position. Operate the LOOP switch to rotate the goniometer rotor until the tone drops off sharply in amplitude, and read the bearing of the transmitting station on the goniometer-indicator.

Communication and Radio Range Operation. With the receiver function switch in the ANT position, the balanced modulator is de-energized and the receiver functions as a conventional communication and low-frequency radio range receiver. The r-f voltage induced in the sense antenna is amplified and detected in the usual manner, and the audio output is fed to the headset.

Loop Operation. With the receiver function switch in the LOOP position, the sense antenna input is grounded, the balanced modulator is unbalanced and functions as an amplifier, and only the loop antenna is used for reception. The goniometer rotor is positioned by the LOOP switch on the control unit.



C-59A CONTROL UNIT



IN-21C GONIOMETER-INDICATOR

TP1644

Figure 3–1. 21B Automatic Direction Finder, Operating Controls and Indicators

SECTION IV
PRINCIPLES OF OPERATION

4–1. FUNCTIONAL DESCRIPTION.

General. The 21B Automatic Direction Finder provides navigation bearings on any continuous radio signal between 190 and 1750 kc. Depending on the position of the dial on the goniometer-indicator with relation to the index, as set by the VAR. knob, the pointer of the goniometer-indicator shows the relative, magnetic, or true bearing of the transmitting station with respect to the heading of the aircraft. The ADF set also functions as a low-frequency radio range receiver and communication receiver. The beat frequency oscillator in the receiver permits identification of keyed CW stations; it may also be used to obtain improved indications of an aural null during loop-only (manual direction finder) operation.

Radio Compass Operation. A block diagram is shown in Figure 4–1. With the function switch of the control unit in the COMP position, the set functions as follows: An r-f voltage is induced in the coils of the loop antenna which is 90° out of phase with the r-f voltage in the sense antenna. The voltages induced in the loop antenna coils are coupled to the stator windings of the goniometer, B2, in the goniometer-indicator. The stator windings produce an r-f field which is identical to the r-f field surrounding the loop antenna. The r-f field in the goniometer is searched by the goniometer rotor. A voltage, which is a function of the rotor angular position, is induced in the rotor winding. This rotor voltage, supplied as a loop input signal to the receiver, is amplified by the

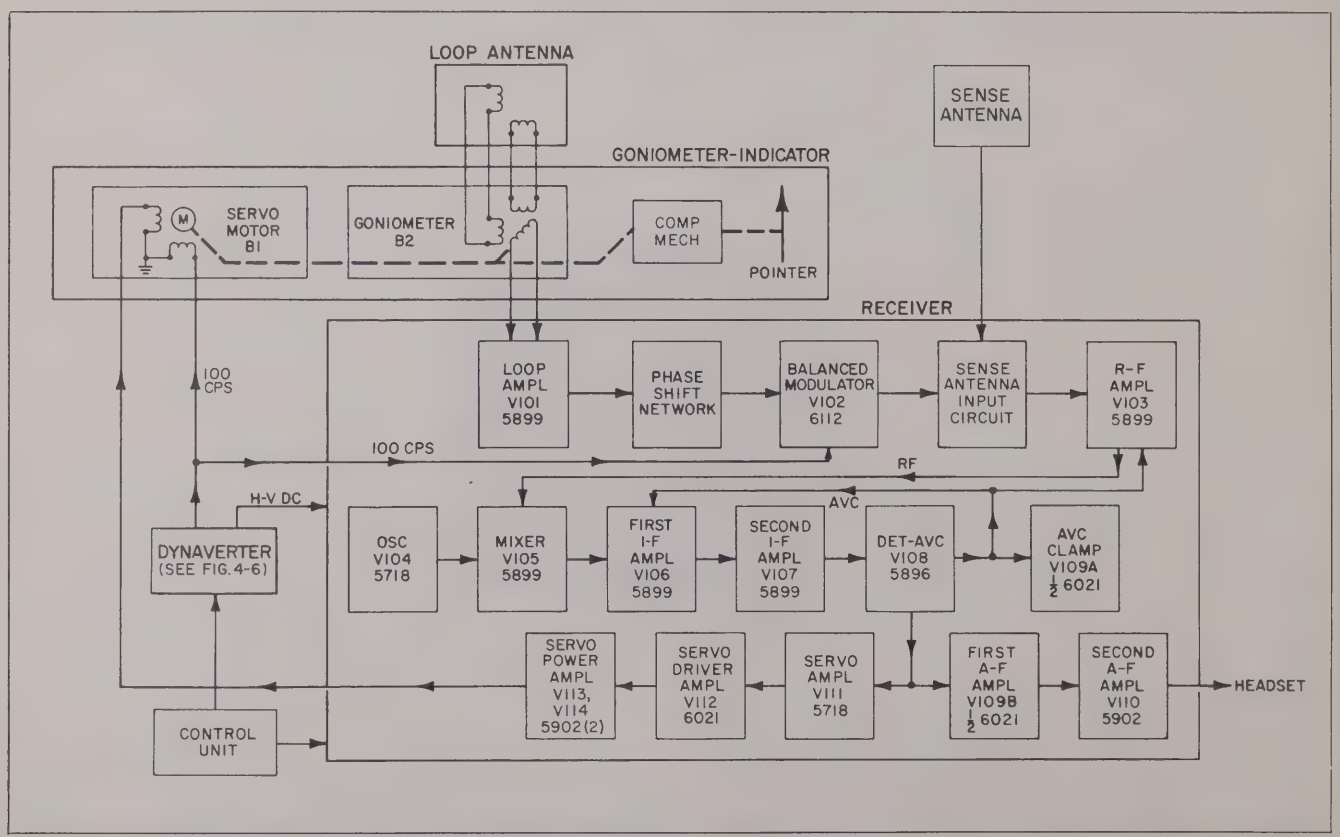


Figure 4–1. 21B Automatic Direction Finder, Block Diagram

loop antenna amplifier, V101, and phase-shifted 90°, resulting in an r-f voltage that is either in phase or 180° out of phase with the sense antenna voltage.

The phase-shifted r-f voltage is fed to the balanced modulator, V102. The balanced modulator has a 100-cps modulating voltage applied to each half, in opposite phase, to provide an output voltage consisting of the carrier frequency plus or minus the modulating frequency. These frequencies appear in the sense antenna input circuit where they add or subtract from the original carrier frequency supplied by the sense antenna. The summation of the frequencies depends upon whether the loop antenna voltage is in phase or 180° out of phase with the sense antenna voltage. The summation of the two signals is applied to r-f amplifier V103.

The output of V103 is combined with the output of local oscillator V104 in mixer V105. The mixer produces an i-f (145.2 kc) voltage that is fed through i-f amplifiers V106 and V107 to the detector-avc stage, V108. The detector detects the 100-cps modulation. The output of V108 is fed through servo amplifier V111, servo driver amplifier V112, and servo power amplifier V113 and V114 to the control winding of servo motor B1 in the goniometer-indicator. The 100-cps output of the Dynaverter is fed to the fixed winding of the servo motor.

The rotors of the servo motor and goniometer are mechanically linked. The direction in which the motor drives the goniometer rotor depends on whether the voltage phase of the motor control winding leads or lags the voltage phase of the fixed winding. When the goniometer rotor is positioned by the servo motor so that no rotor voltage is developed, no 100-cps modulation occurs, no voltage is developed for the servo motor control winding, and the servo motor rotor does not rotate. Since the pointer of the goniometer-indicator is attached to the goniometer rotor through the compensation mechanism, the pointer indicates the compensated bearing of the station being received.

The compensation mechanism is used to adjust the bearing indication when the received signal is distorted by the airframe. The compensation mechanism provides a plus or minus 25° adjustment of the indication every 30° starting at 15°. Additional adjustment is available at 0° and 180°.

Communication and Radio Range Operation. With the function switch in the ANT position, the balanced modulator is de-energized and the receiver functions as a communication and low-frequency radio range receiver. The r-f voltage induced in the sense antenna is amplified and detected in the usual manner, and the audio output is fed to the headset.

Loop Operation. With the function switch in the LOOP position, the sense antenna input is grounded, the balanced modulator is unbalanced and functions as an amplifier, and only the loop antenna is used for reception. The goniometer-indicator pointer is positioned by the LOOP switch on the control unit.

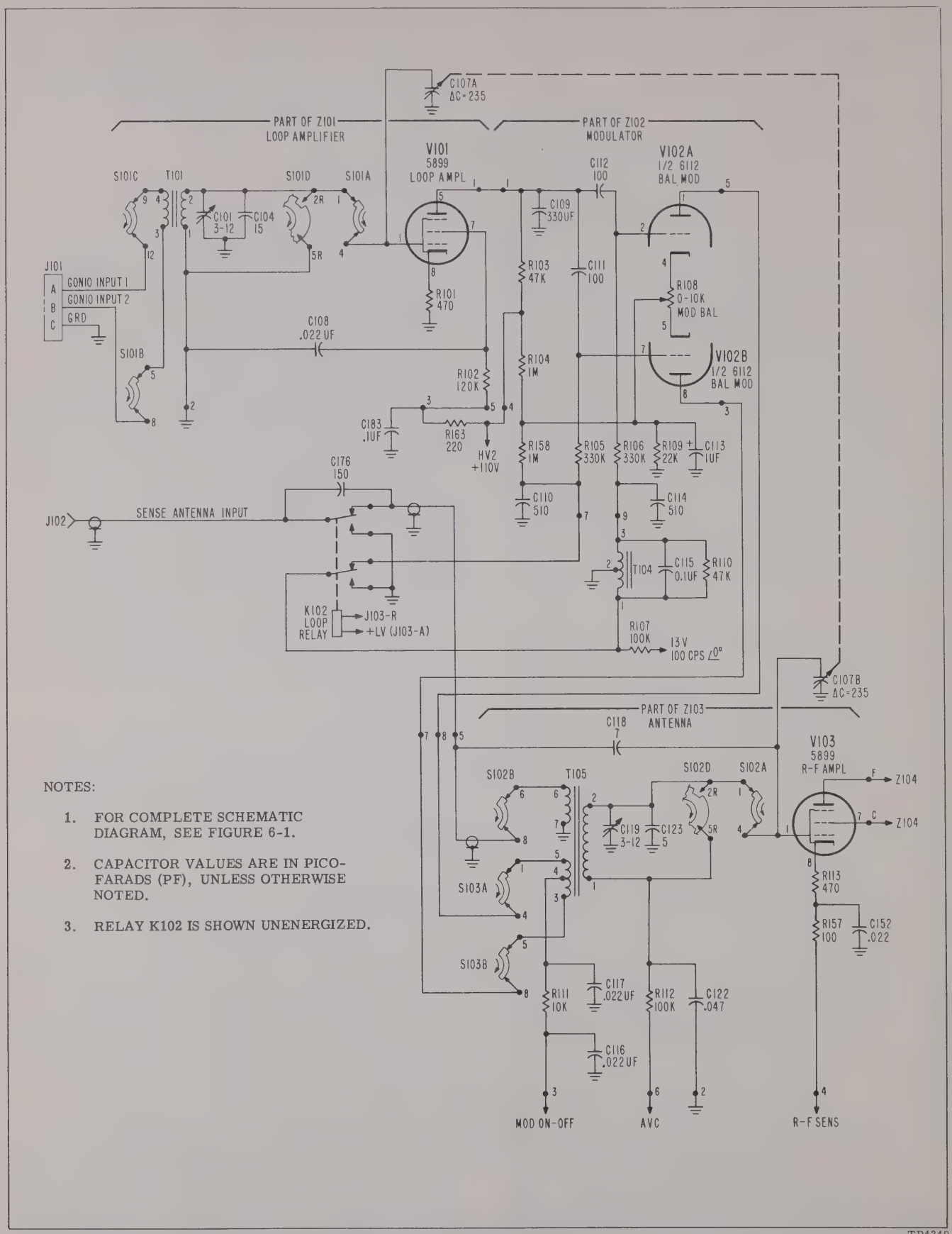
4–2. RECEIVER.

Mechanical Circuit. The main mechanical units of the receiver are the tuning capacitor and the band-switch assembly. The tuning capacitor is positioned by mechanical linkage connected between the control unit and the receiver. The mechanical linkage is connected to the tuning capacitor through a spline which protrudes through the front panel of the receiver. This spline is geared to the capacitor through two bevel gears and a 60:1 reduction worm gear. A spring-loaded gear assembly takes up backlash in the worm gear system. The band-switch assembly consists of a d-c motor, a 4000:1 gear train, and a motor-control switch assembly. The motor operating voltage is supplied through a relay (K101) which is controlled by a rotary switch connected in parallel with a cam-operated Micro switch. When the rotary switch opens and the cam follower drops in the cam notch, the Micro switch opens causing motor relay K101 to disconnect the voltage from the motor and short the motor terminals, thus acting as a dynamic brake. The Micro switch serves as a fine control, since the cam rotates at three times the speed of the rotary switch shaft.

Circuit Description of Compass (COMP) Operation. The functioning of the receiver circuits with the control unit function switch in the COMP position is described in the following paragraphs. A schematic diagram of the receiver is shown in Figure 6–1.

Loop Amplifier. The voltage from the rotor of the goniometer is applied to the primary of a loop transformer, T101, T102, or T103, depending on the band in operation (see Figure 4–2). The secondary of the loop transformer is tuned by C107A and is coupled to the loop amplifier, V101. C109 acts as a capacitor load for the loop amplifier and retards the phase of the loop voltage 90° beyond the 180° phase shift produced by V101. This voltage is either in phase or 180° out of phase with the sense antenna voltage.

Modulator. The output of the loop amplifier, V101, is fed equally to the grids of V102A and V102B, the balanced modulator, through C111 and C112 (see Figure 4–2). The grids of V102A and V102B are also fed at opposite phases by the 100-cycle modulating voltage. The modulating voltage is supplied by the Dynaverter



NOTES:

1. FOR COMPLETE SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
2. CAPACITOR VALUES ARE IN PICO-FARADS (PF), UNLESS OTHERWISE NOTED.
3. RELAY K102 IS SHOWN UNENERGIZED.

TP4349

Figure 4–2. Loop Amplifier and Modulator, COMP and Band I (.19–.40) Positions, Simplified Schematic Diagram

through T104. T104 is resonated to 100 cycles by C115. V102A and V102B have their plates connected to opposite ends of the center-tapped primary of antenna transformer T105, T106, or T107, depending on the band in operation. The modulating voltage causes first one triode section and then the other to amplify the signal, thereby transferring the signal from one end to the other of the center-tapped winding. As this action takes place, the voltage induced in the secondary winding of the selected antenna transformer reverses the r-f phase on alternate halves of the 100-cycle modulating voltage.

Antenna Circuit. The sense antenna voltage is fed to a high-impedance winding of the same antenna transformer used by the modulator circuit (see Figure 4–2). The sense antenna voltage induces a signal voltage in the secondary of the antenna transformer. The signal voltage from the modulator adds to the induced sense antenna signal when one of the triode sections of V102 is amplifying, and subtracts from the induced sense antenna signal when the other section of V102 is amplifying. When the loop antenna is oriented on the other side of its null, the reverse action occurs. The result is a 100-cycle modulation applied to the incoming signal which is either in phase or 180° out of phase with the Dynaverter reference voltage, depending on which side of the null the loop is oriented. The resulting 100-cycle modulated r-f signal is amplified by V103.

First and Second R-f Circuits. The plate of first r-f amplifier V103 is connected to the primary of the first r-f transformer, T108, T109, or T110, depending on the band in use. The secondary is tuned by C107C. The secondary is low-side coupled to a tuned winding of an identical r-f transformer, T111, T112, or T113, depending on the band in use. A common impedance for these transformers is provided by L101, L102, or L103, respectively, depending on the band in use. The low-impedance winding of the second r-f transformer is fed through a miniature coaxial cable to the grid of the mixer, V105.

Oscillator. The oscillator is a tuned-plate, grid-feedback oscillator (see Figure 4–3). Feedback takes place through C134. Series padding is provided for each of the three bands by C137, C139, or C140. The grid feedback winding of the oscillator is coupled directly to the mixer cathode for local oscillator injection. R119, bypassed by C136, serves as the d-c cathode load for the mixer. This resistor and capacitor are located in the oscillator section.

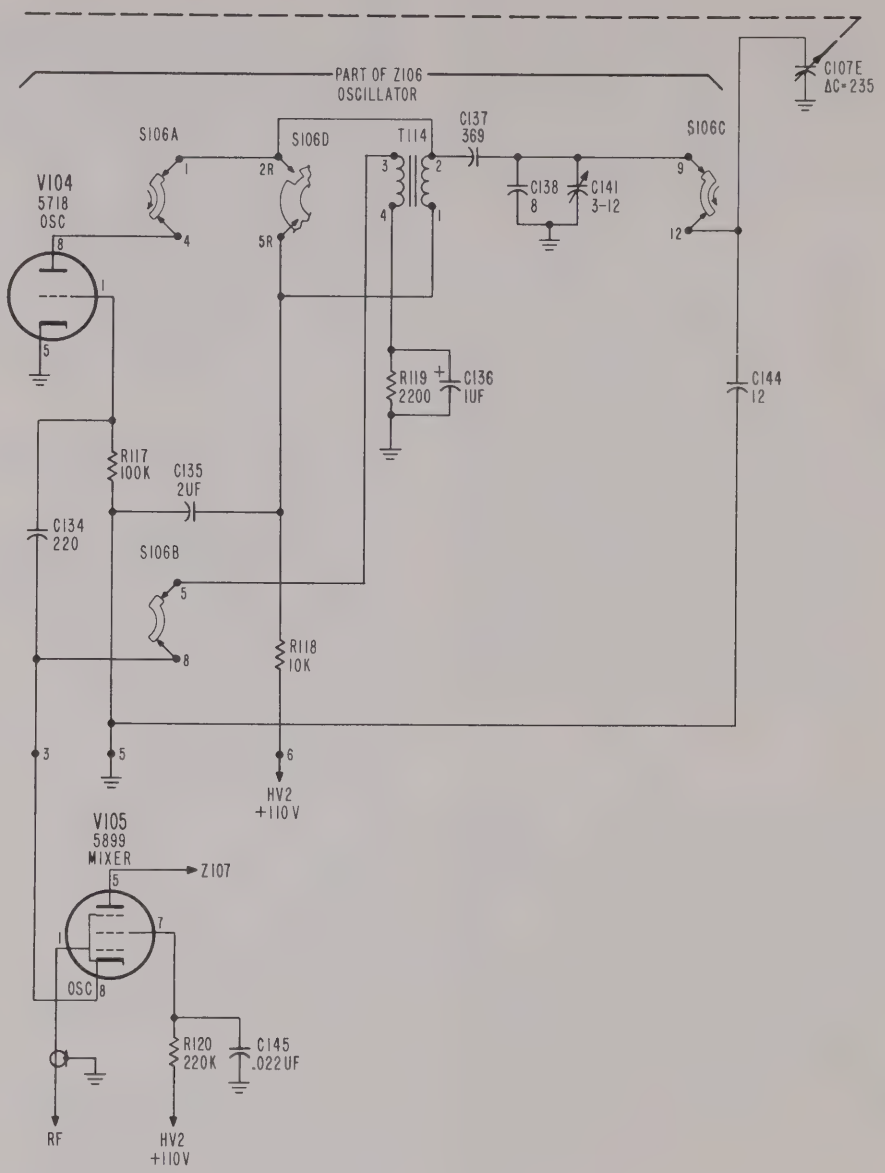
I-f Amplifier. The oscillator frequency is 142.5 kc higher than the signal frequency when tuned on frequency, producing a 142.5-kc intermediate frequency. Double-tuned transformers are used for coupling between the mixer output and the two stages of i-f amplification, V106 and V107, so that a total of three double-tuned i-f transformers is used.

Detector. The second i-f amplifier output is coupled to the detector, V108, by a double-tuned transformer, Z109. The detector output, from the low side of the secondary in Z109, is filtered by C161, C163, and R130. R131 completes the d-c return.

Audio Amplifier. The detector output is coupled to a conventional triode amplifier, V109B, for audio amplification. The output of V109B is coupled to the second audio amplifier, V110. The audio output level is controlled in the grid circuit of V110 by the volume control located in the control unit.

Servo Amplifiers. The detector output, at the junction of C163 and R131, is coupled to the 100-cycle servo amplifiers whose output drives one phase of the loop motor. Coupling to the servo amplifier, V111, is through R141 and C169. The plate of V111 is coupled to V112A (part of the servo driver amplifier) through two resistor-capacitor filter combinations, R147–C170 and R148–C171. This filter suppresses harmonics of 100 cycles and, with other minor phase-shifting components, adjusts the phase relationship between the output of the servo amplifiers and the 100-cycle supply to the fixed phase of the loop motor to 90°, as required for proper motor operation. V112B (part of servo driver amplifier) is a phase inverter whose output, with the output of V112A, drives push-pull servo power amplifier V113 and V114. The output transformer for this 100-cycle amplifier is located in the Dynaverter. The secondary of the output transformer is coupled to the loop motor through the interconnecting wiring of the equipment.

Avc Circuit. The plate of the second i-f amplifier feeds terminals 5 and 7 of avc detector V108. Automatic volume control delay is accomplished by the avc clamp, V109A, and associated resistors R132, R133, and R134. When the detector output is below approximately −10 volts, developed at the detector diode plate, avc action does not take place. Prior to the avc point, avc clamp V109A is conducting because there is a positive voltage applied to the plate through R134. However, the avc line does not go positive due to the conducting action of the clamp tube. When the developed negative voltage at the avc detector plate, terminal 5 of V108, exceeds approximately −10 volts, the avc clamp tube stops conducting and the avc line goes negative. The amount that the avc line goes negative depends on the strength of the received signal. The avc voltage controls the grid bias of r-f amplifier V103, and first i-f amplifier V106.



NOTES:

1. FOR COMPLETE SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
2. CAPACITOR VALUES ARE SHOWN IN PICOFARADS (PF), UNLESS OTHERWISE NOTED.

TP4351

Figure 4–3. Oscillator and Mixer, Band I (.19–.40) Position, Simplified Schematic Diagram

Disabling Circuit. When the band selector is in operation, the audio output is eliminated in the cathode circuit of V109B to remove undesired noise. While the band selector is in operation, the primary input voltage, 27.5 or 13.75 volts dc, is applied to one end of R136 to bias V109B to cut-off so that no amplification takes place in this stage during band-switching.

Circuit Description of Antenna (ANT) Operation. When the control unit function switch is in the ANT position, the function of the receiver circuits is the same as for compass operation, except for the modulator and volume control circuits.

Modulator. During ANT operation, the modulator is deenergized by the function switch which grounds terminal D of J103. Terminal D, which is connected to terminal 3 of Z103, removes plate voltage from the modulator by grounding the plate-end of series resistor R114.

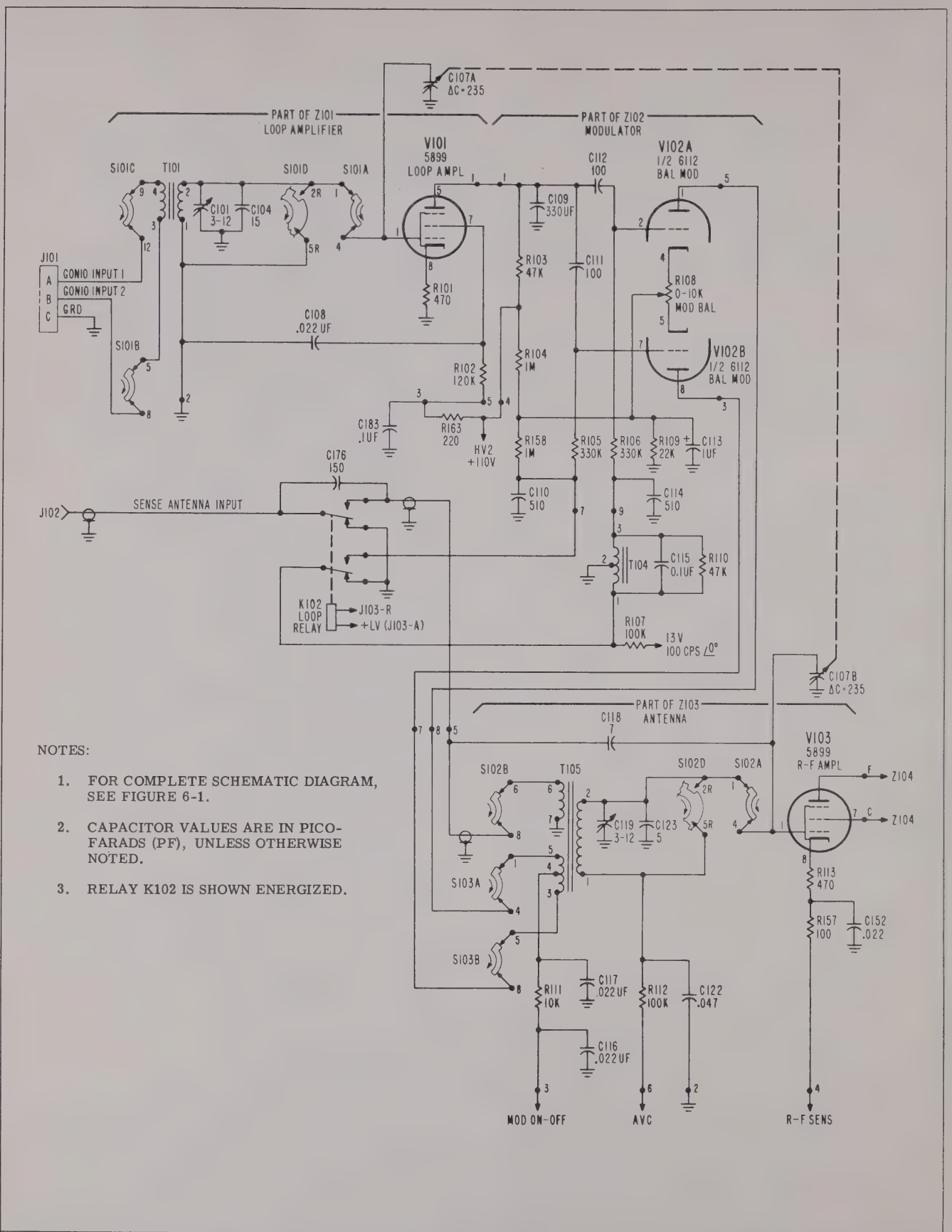
Volume Control. During ANT operation, the VOL control in the control unit is connected to control the r-f sensitivity of the receiver instead of the audio level by removing the ground connection from terminal K of J103 in the receiver, and allowing the resistance between this point and ground to be varied by R201A located on the VOL control shaft. R201A varies the cathode bias of V103 and V106, the cathode loads of which are returned to terminal K of J103 (SENS line). R124 applies a limited amount of d-c current from the HV2 supply to the SENS line to insure a sufficient reduction in sensitivity under very high signal level conditions. The audio gain is held nearly constant at maximum gain during ANT operation. The function switch disconnects the low side of the audio level potentiometer, R201B, from ground for ANT operation. By maintaining maximum audio gain and controlling the r-f sensitivity during ANT operation, the receiver operates below the avc point when the audio output is set at a comfortable level. To eliminate the ambiguity of the A and N coded sidebands, operation below the avc point is desirable when receiving low-frequency radio range transmissions that do not have an omnidirectional radiated carrier.

Circuit Description of Loop (LOOP) Operation. When the control unit function switch is in the LOOP position, the receiver functions the same as during compass (COMP) operation, except for the volume, antenna, and modulator circuits. The volume control circuit operates as an r-f sensitivity control (as during ANT operation). The differences in the antenna and modulator circuits are as follows: In the LOOP position, K102 in the receiver is energized (see Figure 4–4). The relay contacts ground the sense antenna input, terminate the antenna transformer (T105, T106, or T107) in a 150-pf capacitor to maintain optimum tuning, short out the 100-cycle input to the balanced modulator, and unbalance the modulator to make it function as an amplifier.

Beat Frequency Oscillator. The beat frequency oscillator (BFO) is a transistor tuned-collector oscillator, tuned to 143.4 kc. The output of the BFO is fed to the grid of V107, the second i-f amplifier, through C177. The operation of the BFO is controlled by the BFO switch on the control unit. When the BFO switch is in the OFF position (switch closed), the junction of R159 and R160 is grounded removing B+ from the transistor. When the BFO is operating, a small voltage (at 143.4 kc) is injected into the second i-f amplifier so that a properly tuned CW signal passing through the second i-f amplifier (at 142.5 kc) will produce a 900-cycle beat note with the BFO. After amplification, the 900-cycle signal appears in the audio output of the receiver. If the receiver tuning is changed slightly, the signal frequency passing through the second i-f amplifier is changed, and the beat note frequency (tone) will change correspondingly. As the receiver is tuned from one side of the signal to the other, the beat note will decrease from a high audio-frequency to zero, and then increase again on the other side of zero beat; thus, there are two receiver tunings which will produce a 900-cycle tone. Since the i-f bandpass is narrow (6 db down at 4.5 kc), only one tuning may be used for proper operation. For example: If the receiver tuning is increased by 1.8 kc from the proper point, the signal frequency in the second i-f amplifier will become 144.3 kc, instead of 142.5 kc. This frequency will beat with the 143.4-kc signal from the BFO to produce a 900-cycle tone output again. While the tuned frequency is being increased, the tone output will decrease in frequency from 900 cycles to 0 and then rise again. Because of the narrow i-f bandpass, the centered 142.5-kc signal will be amplified as intended, but the 144.3-kc signal will be relatively attenuated; also, if the receiver is tuned 1.8 kc on the high side of the desired frequency, interference may be encountered from signals on the adjacent channel. Therefore, the receiver should be tuned to the lower of the two adjacent control unit dial readings at which a 900-cycle tone is obtained.

4–3. LOOP ANTENNA.

The loop antenna consists of two coils wound at right angles to each other on a ferrite core. The loop antenna is mounted with the plane of one coil parallel to the longitudinal axis (fore-and-aft line) of the aircraft. The plane of the other coil is parallel to the lateral axis (wing tip to wing tip) of the aircraft. The voltage induced in the longitudinal coil is a function of the cosine of the angle formed by the intersection of a line to the trans-



NOTES:

1. FOR COMPLETE SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
2. CAPACITOR VALUES ARE IN PICO-FARADS (PF), UNLESS OTHERWISE NOTED.
3. RELAY K102 IS SHOWN ENERGIZED.

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Figure 4–4. Loop Amplifier and Modulator, LOOP and Band I (.19–.40) Positions, Simplified Schematic Diagram

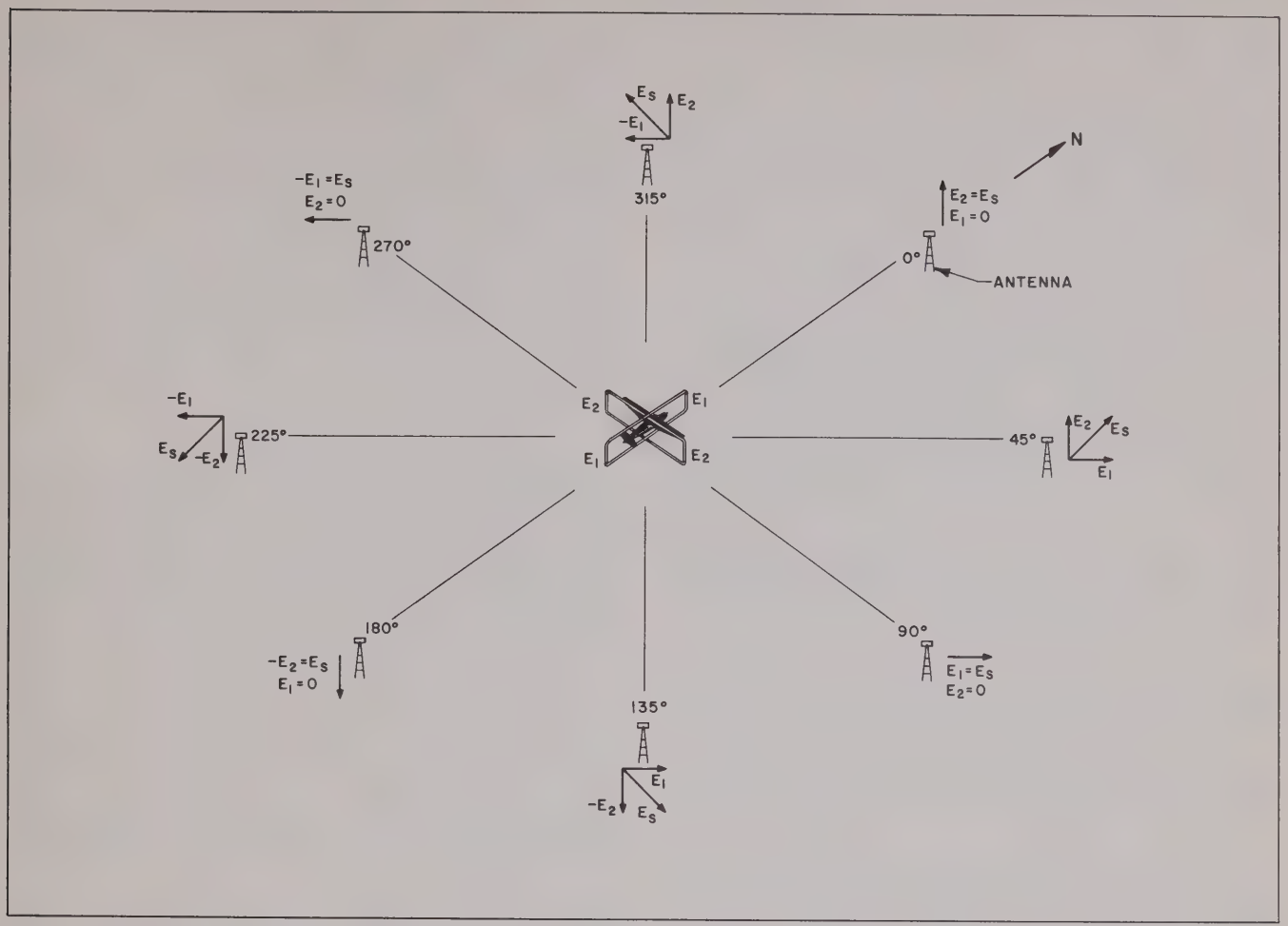

Figure 4–5. Loop Antenna Voltage Relationships

mitting station and the longitudinal axis of the aircraft. The voltage induced in the lateral coil is a function of the sine of the same angle.

Figure 4–5 is a plan view of a loop antenna surrounded by low-frequency radio stations located at 45-degree intervals. A vector diagram of the coil voltages induced in the loop antenna is shown for each radio station.

4–4. CONTROL UNIT.

General. The control unit includes a function switch, a VOL control, a LOOP switch, a tuning crank, a tuning meter, a BFO switch, and an MC BAND switch. The functions of these controls are described in paragraph 1–5 and Table 3–1. When the function switch is in the COMP position, the loop and modulator circuits of the receiver are energized and the VOL control functions as an audio level control, with the r-f sensitivity controlled by avc action. In the ANT position, the loop and modulator circuits are de-energized and the VOL control becomes an r-f sensitivity control. In the loop position, the modulating voltage is removed, the balanced modulator is unbalanced, the sense antenna input is removed, and the VOL control functions as an r-f sensitivity control.

COMP Operation. With the function switch in the COMP position, the control unit circuit is connected as follows:

1. The negative terminal of the tuning meter, M201, is grounded by S204, which grounds terminal P of J201 through the tuning meter. Under this condition, the receiver operates at a maximum r-f gain with no signal, and the gain is regulated by avc action according to signal strength.

2. The cathode current of the r-f and first i-f amplifiers in the receiver flows through the tuning meter. The meter is arranged with a zero-current indication at the right. With no signal input, the meter reads to the left because there is minimum bias and maximum current flow through the r-f and first i-f amplifier tubes. As the signal is increased, the negative avc voltage increases and the total cathode current decreases, causing the meter to read further to the right.

3. The low side of R201B is grounded so that the VOL control functions to control the audio output of the receiver.

4. The low side of the 100-cycle output transformer (T704 in the Dynaverter) is grounded (through terminal L of J701) by S204 to complete the loop motor drive circuit for COMP operation.

5. The MC BAND switch, S203, grounds terminal F, G, or H of J201, as required.

6. The LOOP switch, S201, permits connecting terminal K of J201 to either terminal L or M of J201. Terminal M of J201 is connected directly to the 100-cycle output of the Dynaverter in installations where the sense antenna is belly-mounted. Terminal M, connected to a phase reversing transformer (T703) in the Dynaverter, provides a voltage 180° out of phase with the voltage on terminal L of J201. The power on-off switch, S202, which is part of the VOL control, grounds terminal Q of J201 when the equipment is turned on to energize the power relay in the Dynaverter.

ANT Operation. With the function switch in the ANT position, the control unit is connected as follows:

1. Terminal R of J201 is grounded to remove the plate voltage from the receiver modulator circuit, thereby disabling the loop circuits.

2. R201A is connected into the circuit so that the VOL control functions as an r-f sensitivity control. The low end of R201B is removed from ground. The audio gain is then always near its maximum value.

3. In ANT operation, the tuning meter is affected by the position of the VOL control. The tuning meter reads further to the right as the r-f gain of the receiver is decreased by turning the VOL control counterclockwise.

LOOP Operation. With the function switch in the LOOP position, the control unit circuit is connected as follows:

1. Terminal N of J201 is grounded to energize the loop relay, K102, in the receiver.

2. Terminal 11 of S204 is disconnected from ground, and terminal P of J201 is grounded through R201A so that the VOL control functions as an r-f sensitivity control. Terminal 8 of S204 is disconnected from ground, preventing the servo motor in the goniometer-indicator from being energized by the noise output of the servo amplifiers, thereby preventing the pointer of the goniometer-indicator from wandering.

3. The low end of R201B is disconnected from ground and the audio gain is always near its maximum value.

4. The tuning meter is affected by the position of the VOL control. The tuning meter reads further to the right as the r-f gain is decreased by turning the VOL control counterclockwise.

5. The LOOP switch, when held either to the left or right, supplies the 100-cycle signal to the servo motor in the goniometer-indicator in such phase as to drive the servo motor either clockwise or counterclockwise. One side of the switch reconnects ground to terminal 5 of T704 (through terminal L of J701 on Dynaverter) to complete the servo motor drive circuit. The other side of the switch connects the 100-cycle voltage of either the 0° or 180° phase to servo amplifier V111 to provide drive to the servo motor in the goniometer-indicator through the remaining servo amplifiers and T704.

4–5. GONIOMETER-INDICATOR.

The IN-21B and IN-21C Goniometer-Indicators contain a servo motor, goniometer, and compensation mechanism. In addition, the IN-21B Goniometer-Indicator contains a synchro transmitter which is not contained in the IN-21C Goniometer-Indicator.

Servo Motor. The servo motor provides the torque necessary to turn the goniometer rotor, pointer, and, if included, the stator of the synchro transmitter. Operation of the motor is governed by two voltages which are applied to the fixed and the control windings. The motor will operate only when these two voltages are displaced in phase by 90 degrees.

Goniometer. Each cross-wound coil of the fixed loop antenna is connected to a stator coil in the goniometer. The voltages induced in the coils of the fixed loop antenna cause proportional currents to flow through the goniometer stators. These currents produce proportional magnetic fields that combine vectorially to form a resultant magnetic field. The resultant magnetic field assumes the same direction as the transmitted signal from the station being received.

The resultant magnetic field induces a voltage in the goniometer rotor coil. The amplitude and phase of this induced voltage is determined by the angular displacement between the axis of the rotor coil and the axis of the resultant magnetic field. When the two axes are parallel, the voltage induced in the rotor is maximum. When the two axes are displaced by 180 degrees (parallel but mutually inverted), the voltage induced in the rotor will again be maximum but of the opposite polarity. Similarly, there are two positions of the goniometer rotor coil that produce zero output voltage. This result occurs when the axis of the goniometer rotor coil is at right angles to the axis of the resultant magnetic field.

Compensation Mechanism. The compensation mechanism, which corrects for bearing errors caused by struc-

tural members of the aircraft, consists of a vertically mounted circular track whose shape is adjustable by 14 screws. The screws are accessible after removing the dust cover and lowering the hinged rear plate. They are spaced around the track at 30-degree intervals, except in the forward and aft 30-degree sectors where they are spaced 15 degrees apart. A spring-loaded roller, which rides on a track, mechanically varies the position of a gear train between the goniometer, pointer, and synchro transmitter. Varying the gear position compensates for errors introduced by the structural members of the aircraft. The goniometer shaft drives a drum which indicates the direction of arrival of the incoming signal.

Synchro Transmitter. In the IN-21B Goniometer-Indicator only, a synchro transmitter translates the displacement information of the pointer into an electrical signal voltage. This signal voltage represents the difference between the bearing of the selected station and the position of the goniometer rotor. The voltage is applied to a remote bearing indicator, which repeats the bearing indications of the IN-21B Goniometer-Indicator.

4–6. DYNAVERTER.

General. The Dynaverter operates from the aircraft's primary d-c supply and generates two outputs: 125 volts dc and 13 volts ac. As shown in the block diagram, Figure 4–6, the 125-volt dc supply consists of a multivibrator switching circuit, a power transformer, and a full-wave diode rectifier. The 13-volt ac supply consists of a 100-cps push-pull oscillator, a push-pull power amplifier, and a 100-cps output transformer.

125-volt Dc Supply. The principles of operation of the 125-volt dc supply are as follows: Low-voltage dc from a primary source is applied to two high-power transistors connected in a self-excited multivibrator switching circuit. This circuit furnishes reversing-polarity square-wave pulses to the primary winding of a power transformer. The secondary winding of the transformer provides a square-wave alternating current that is rectified and filtered to provide the desired high-voltage dc output. The magnitude of this voltage depends on the primary-secondary turns ratio of the transformer. The transformer also has two feedback windings that control the switching action of the transistors.

A schematic diagram of the basic inverter circuit of the Dynaverter is shown in Figure 4–7. Assume that at the instant the circuit is energized a slight imbalance in transistors Q1 and Q2 causes more current to flow in winding 3 than in winding 2 of transformer T1. The flux in the transformer core begins to change toward saturation in one direction at a linear rate, since the product of the flux rate of change and the number of turns must equal the battery voltage (neglecting the small back voltage due to the IR drop).

The change in flux induces voltages in windings 1 and 4, making them positive at A and B. The base of transistor Q2 becomes negative with respect to its emitter, and

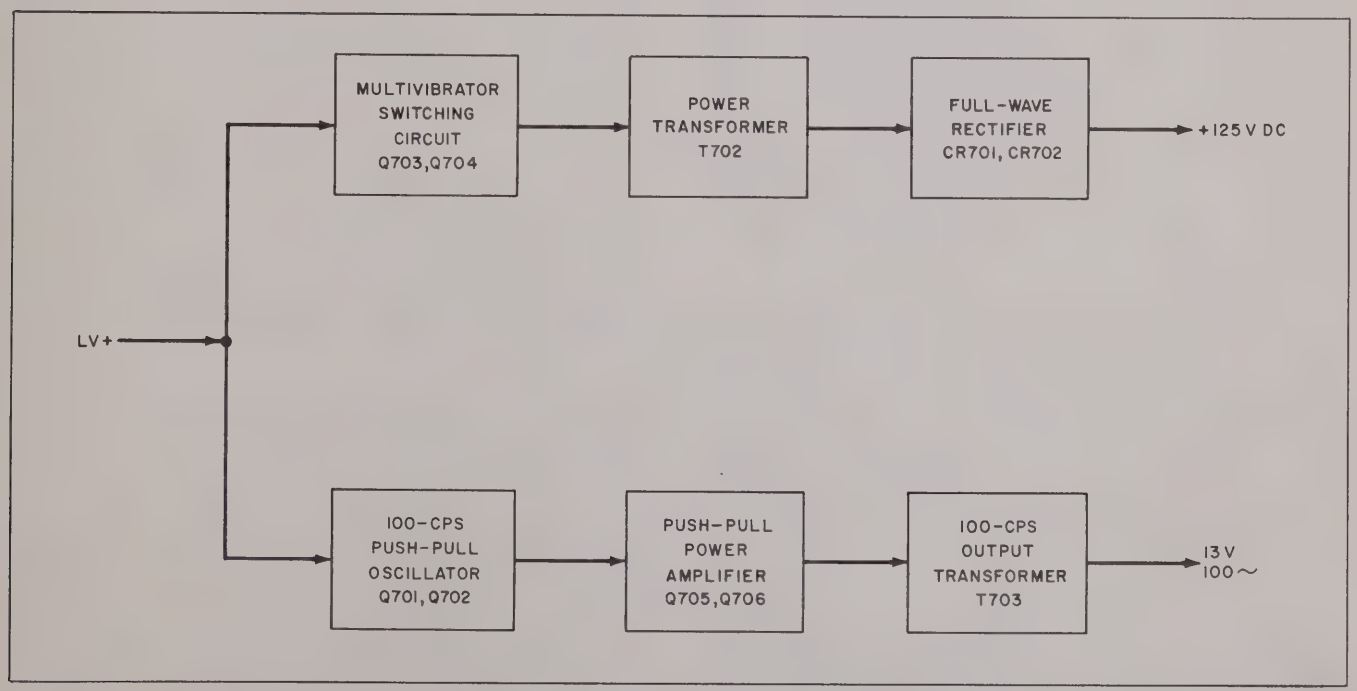

Figure 4–6. Dynaverter, Block Diagram

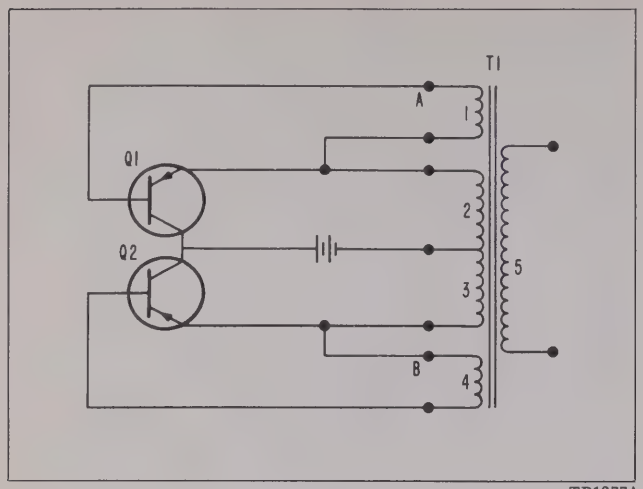

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Figure 4–7. Basic Transistor Inverter Circuit

the base of transistor Q1 becomes positive with respect to its emitter. Under these conditions, Q2 becomes saturated (low resistance from emitter to collector) and Q1 is cut off (high resistance from emitter to collector).

When Q2 is saturated, almost all of the input voltage appears across winding 3 and the flux in the core of the transformer increases until saturation occurs. When the core becomes saturated, the flux ceases to change. Consequently, the induced voltages in windings 1 and 4 drop to zero, causing Q2 to cut off and the current in winding 3 to decrease.

The decrease of current in winding 3 causes a decrease of flux in the core of the transformer. The changed flux induces voltages of such polarity in windings 1 and 4 that they become negative at A and B. As a result, Q2 cuts off completely, Q1 becomes saturated, and current increases in winding 2 until saturation of the core occurs in the opposite direction. During this time, the voltages induced in windings 1 and 4 keep Q2 cut off and Q1 saturated. When the core of the transformer becomes saturated, the switching again takes place.

The switching action of the transistors continues to repeat. Current flows alternately in windings 2 and 3, inducing a square-wave alternating voltage in winding 5 of the transformer. The frequency of the alternating wave output depends on the applied voltage, the number of turns in the primary winding, the cross-sectional area of the core, and the saturation flux density of the core. At nominal input voltage, the multivibrator switching circuit operates at approximately 2800 cps.

The schematic diagram for both the 14-volt and 28-volt models of the DV-14A is shown in Figure 6–15. Basically, the multivibrator switching circuits for the two models are the same, but since the input voltages are different the resistor values and the turns ratios of the power transformers are different. Forward bias for the multivibrator switching transistors, Q703 and Q704, is provided by R704 and R706, and R705 and R707, respectively.

The output of power transformer T702 is rectified by CR701 and CR702. A capacitor input filter consisting of C708, L703, C716, L702, and C711 is used to filter the 125-volt dc rectifier output. R710 is a bleeder resistor, and C707 is an r-f bypass capacitor for the rectified output. T704 is the output transformer for the 100-cps push-pull amplifier, V113, and V114, in the receiver. The output of T704 is applied to the control winding of the goniometer-indicator servo motor.

13-volt, 100-cps Supply. The principles of operation of the 13-volt, 100-cps supply are as follows: Two 2N1183B p-n-p transistors, Q701 and Q702, are used in a self-excited, push-pull oscillator (see Figure 6–15) to generate a 100-cps signal. The frequency is determined by the parallel resonant circuit of C703 and primary winding 1–3 of transformer T701. Center-tapped winding 5–7 of T701 is used as the feedback winding to the bases of Q701 and Q702. Forward bias is provided by R701 and R702. C714 and C715 are negative feedback capacitors used to reduce r-f noise in the oscillator. Two 2N375 p-n-p power transistors, Q705 and Q706, connected in a push-pull, common-collector circuit, are used as the power amplifier for the a-c supply. The 100-cps signal from the push-pull oscillator is amplified by Q705 and Q706 and then coupled to power output transformer T703 to form a 13-volt ac supply. Q705 and Q706 are connected for Class B operation with their bases and emitters returned to the low-voltage supply through the center-tapped windings of T701 and T703, respectively. C705 and C706 are neutralizing capacitors used to prevent parasitic oscillations of the push-pull circuit. The a-c supply is taken from center-tapped secondary winding 4–6 of T703. Since the center tap is grounded, winding 4–6 furnishes two 13-volt, 100-cps ac voltages which are 180° out of phase with each other. Extension winding 6–7 of T703 and C710 and C713 are used as a power-factor correction network for the a-c load.

K701 is the power relay for the 21B ADF equipment. CR703, connected in series with the solenoid of K701, prevents operation of the Dynaverter if the input power leads are accidentally reversed in polarity. R709 is a voltage-dropping resistor for the receiver electron tube heaters and is used in the 28-volt model only. L701 and C704 form a low-pass input filter for all transistor circuits to prevent possible transistor damage due to input power transients. C709 is an r-f bypass capacitor for the receiver electron tube heaters and the low-voltage input.

SECTION V
MAINTENANCE

5–1. INTRODUCTION.

This section contains maintenance information for the 21B Automatic Direction Finder. Included are a list of test equipment and accessories required for maintenance, lubrication instructions, removal and replacement procedures, disassembly procedures, performance checks, alignment and adjustment instructions, and voltage, resistance, and stage gain measurements. Schematic and wiring diagrams are shown in Section VI.

WARNING

VOLTAGES USED IN THIS EQUIPMENT MAY BE FATAL IF CONTACTED. OBSERVE ALL SAFETY PRECAUTIONS.

5–2. TEST EQUIPMENT AND ACCESSORIES.

Table 5–1 lists the test equipment and accessories required for maintenance of the 21B; equivalent test equipment and accessories may be substituted. Use of the BTK-21C is recommended to facilitate maintenance procedures. If the BTK-21C is not available, either the SA-40C Antenna Position Simulator (which is part of the BTK-21C) or a calibrated screen room is required.

If a calibrated screen room[1] is used, provision must be made for the sense antenna input to the receiver. For this purpose, an r-f capacitive line divider must be connected between the signal generator, which energizes the screen room radiating wire, and the sense antenna cable. This line divider must have an attenuation of 4:1 for ¼-meter effective height times the screen room field attenuation factor[2] and, in addition, must have an output capacitance of 50 pf. An r-f line divider for a screen room and a table listing the capacitor values for several room factors are shown in Figure 5–1. The addition of a 50-pf dummy antenna capacitor and a DPDT switch as a function selector switch provides a convenient method of selecting either the REC (ANT) or ADF (COMP) signal input for the receiver.

[1]The construction and calibration of a suitable room is described in RTCA Paper 83-85/DO-70, RTCA Secretariat, 16 and Constitution Avenues N.W., Washington 25, D. C.

[2]Screen room attenuation factor $= \frac{\text{signal generator output } (\mu v)}{\text{field strength } (\mu v/\text{meter})}$

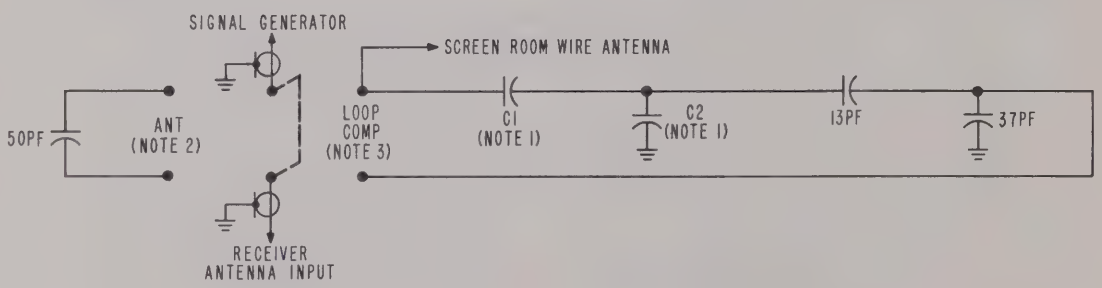
TABLE 5–1. TEST EQUIPMENT AND ACCESSORIES

Qty	Name	Designation or Characteristics
	TEST EQUIPMENT	
1	Audio Oscillator	Hewlett-Packard Model 200AB
1	Bearing Indicator	ARC Type IN-12-1
1	Bench Test Kit consisting of:	ARC Type BTK-21C
1	Adapter Assembly	22770
1	ADF Test Panel	19770
1	Antenna Position Simulator[1]	SA-40C
1	Cable Assembly	33691
		33893[2]
1	Knob	18802
1	Loop Antenna Cable Assembly[1,3]	32803
1	Mechanical Linkage (5 feet)[1]	16158-0060
1	Receiver Cable Assembly[1,3]	33785-0010
1	Right-angle Coupling	6357
1	Sense Antenna Cable Assembly[1,3]	17984
1	Shaft Extension	21330
1	Test Harness (for DV-14A)	27579
1	Crystal Calibrator	Measurements Model 111-B
1	Frequency Meter[3]	94–116 cps, 10–15 volts
1	Multimeter	Simpson Model 260
1	Oscilloscope	Tektronix Model 310

TABLE 5–1. TEST EQUIPMENT AND ACCESSORIES — Continued

Qty	Name	Designation or Characteristics
	TEST EQUIPMENT — Continued	
1	R-f Voltmeter	Boonton Electronics Model 91C
1	Signal Generator	Measurements Model 65-B
1	Screen Room[4]	
1	Stop Watch	
1	Voltmeter	Hewlett-Packard Model 410B
1	Voltmeter	Ballantine Model 300D
1	Voltmeter	0–20 volts ac
	ACCESSORIES	
1	Adapter	UG-273/U (11368)
AR	Cable	RG-58/U (11318)
1	Capacitive Line Divider	See Figure 5–1
5	Connector	UG-88C/U (11337)
1	Connector	UG-274/U (14129)
1	Connector	33286-0001
1	Connector	33874
1	Connector	33877-0009
1	Connector	14491
2	Connector[3]	16115
1	Connector[3]	33979
1	Connector	16742
1	Resistor	300-ohm, ½-watt

[1]Available as separate item.
[2]Available on special order; contains provisions for monitoring input current.
[3]Required if BTK-21C is not used.
[4]Required if SA-40C is not used.



NOTES:
1. TO DETERMINE VALUE OF C1 AND C2 (IN pF) FOR ANY ROOM FACTOR, USE THE FOLLOWING FORMULA:

$$\text{ROOM FACTOR} = \frac{C1 + C2}{C1}$$

FOR KNOWN ATTENUATION RATIOS, THE FOLLOWING CHART MAY BE USED.

ROOM FACTOR	10:1	9:1	8:1	7:1	6:1	5:1	4:1	3:1
C1 (pF)	100	100	100	100	100	100	100	100
C2 (pF)	900	800	700	600	500	400	300	200

2. IN ANT POSITION, THE SIGNAL GENERATOR INDICATES THE ANTENNA OPEN-CIRCUIT MICROVOLTS DIRECTLY.
3. IN COMP POSITION, THE SIGNAL GENERATOR OUTPUT DIVIDED BY THE ROOM FACTOR IS EQUAL TO MICROVOLTS/METER FIELD STRENGTH.

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Figure 5–1. Capacitive Line Divider for Screen Room

5–3. LUBRICATION.

When necessary, lubricate the bearings, gears, coil springs, balls, and wear surfaces of the C-59A or CC-14A dial gearing with Aeroshell Grease No. 7, or equivalent. If the tuning crank of the C-59A or CC-14A binds, lubricate it with Esso Beacon Grease No. 325, or equivalent. Before applying new lubricant to any surface, remove the old lubricant with a stiff brush or clean cloth and solvent.

5–4. REMOVAL AND REPLACEMENT PROCEDURES.

General. Partial disassembly of the receiver is required to replace the r-f assemblies. The electron tubes, transistors, and most other electrical parts in the receiver and Dynaverter can be replaced without disassembly. The wiring diagrams in Section VI will aid in locating and identifying the parts. After a part has been replaced, the operation of the equipment should be checked. If any parts are replaced in the r-f assemblies, check the performance of the receiver as outlined in Table 5–3 and realign, if necessary, as outlined in Table 5–5.

The separate parts catalog for the 21B ADF includes detailed parts lists, interior views, and exploded views for the units and accessories. These lists and illustrations should be referred to if detailed disassembly of any of the units or their assemblies is required. Except for attaching parts which are listed after the part they attach, parts are listed and numerically indexed in disassembly order.

Removal of Dust Covers. The receiver has two dust covers. One cover, enclosing all the receiver subassemblies except the band switch assembly, is secured by six screws: two on each side near the bottom edge, and one each on the top and bottom near the forward edge. The dust cover for the band switch assembly is secured by three screws on the front of the unit.

The C-59A Control Unit dust cover is secured by two Dzus fasteners at the rear of the unit. The dust cover for the CC-15A Control Unit is secured by a single Dzus fastener at the rear of the unit. Two binding head screws at the rear of the CC-14A Control Unit secure its dust cover.

To remove the Dynaverter dust cover, first remove the four transistors on the top of the unit (each transistor is attached by two stop nuts). Then remove three screws from each side near the bottom edge. The dust cover is removed by lifting it upwards away from the main chassis.

Replacement of Parts in Receiver I-f/A-f Circuits. The parts of the i-f/a-f circuits are mounted on a hinged terminal board. To expose these parts, remove the main receiver dust cover. Unscrew the conical stud and the screw located to the left of J103 on the front panel. Set the tuning capacitor to its fully meshed position (maximum capacity). From the top of the receiver chassis, remove the screw near the rear of the capacitor and the screw near the middle of the capacitor. Turn the receiver over and fold the terminal board down.

Replacement of Tubes. All tubes in the receiver are subminiature types. These tubes use flexible leads which are soldered directly to a terminal point. When replacing a tube, the new tube should be oriented and its leads routed as nearly as possible like the original installation. Tube locations are shown in Figure 5–2; their wiring diagrams are referenced in parentheses. When replacing a tube, do not precut the leads before installation, keep the spacing between leads at least 1/16 inch, and use a minimum amount of solder.

Removal of Receiver R-f Assemblies. In general, the procedure for removing any of the r-f assemblies is as follows:

Step 1. Set tuning capacitor to its fully meshed position (maximum capacity) to prevent accidental damage to rotor blades.

Step 2. Remove main receiver dust cover and band switch assembly cover. Disconnect six wires from terminal board in lower left of band switch assembly. Remove three screws securing assembly to front panel and withdraw assembly from receiver.

CAUTION

Do not disturb any setscrews or other adjustments in the band switch assembly.

Step 3. Unsolder connections from r-f assembly to be removed and lead from tuning capacitor. Remove six screws (four on top and two below deck) which hold assembly in place. When removing loop assembly, Z101, it is also necessary to unsolder connections to loop cable at J101 and pull these leads up through hole in chassis.

Step 4. Slide assembly sideways to remove.

As an alternative procedure for removing the oscillator and second r-f assemblies, which are located at the rear, it is possible to leave the band switch assembly in place and remove the assembly desired by pulling it off the shaft toward the rear of the receiver. The oscillator assembly may be removed alone, but to remove the second r-f assembly, it is necessary to remove the oscillator assembly.

Replacement of Receiver R-f Assemblies. To replace any of the receiver r-f assemblies, reverse the procedures outlined previously for removal. Observe the following precautions: Carefully inspect the front and rear wafer switch contacts before replacing the assembly in the receiver. Before engaging the long switch shaft in any

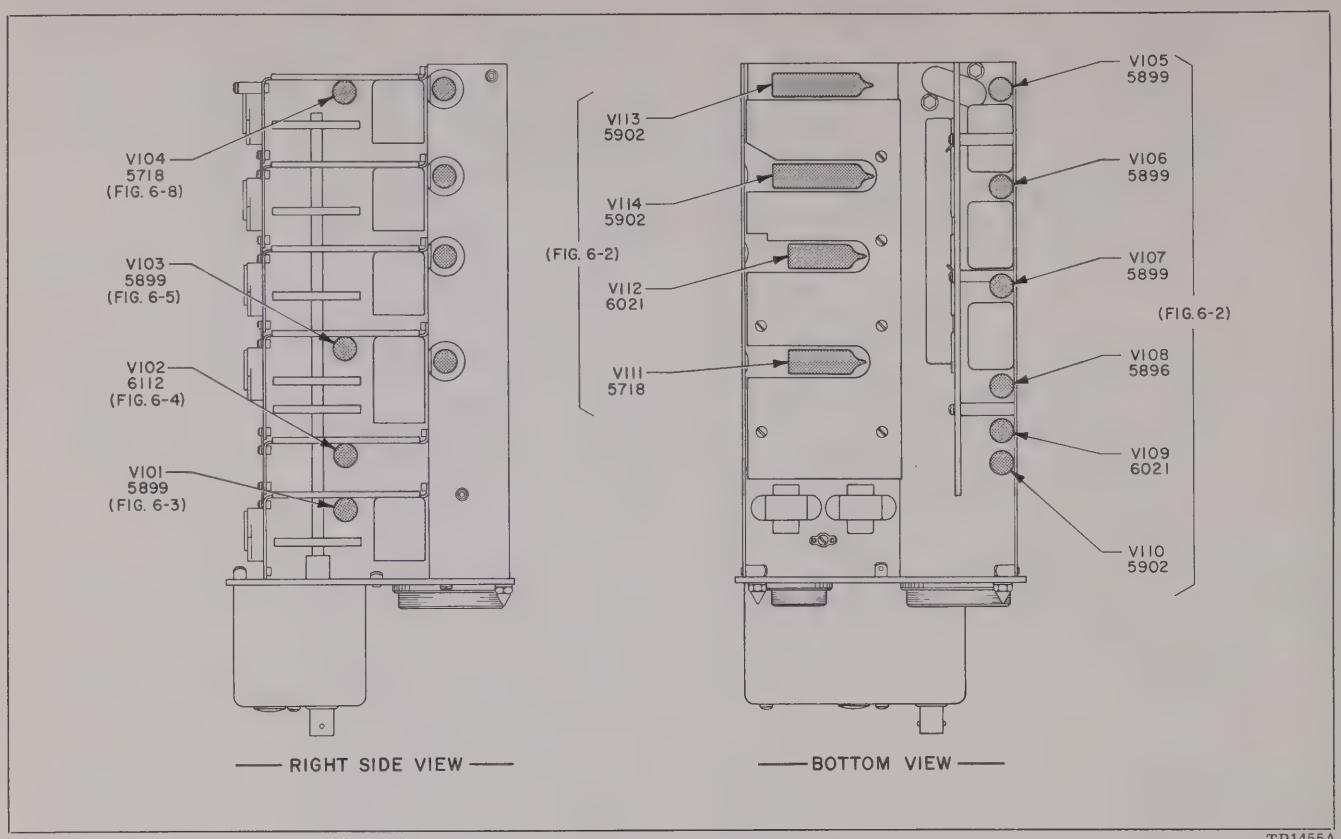


Figure 5–2. R-30B Receiver, Tube Location Diagram

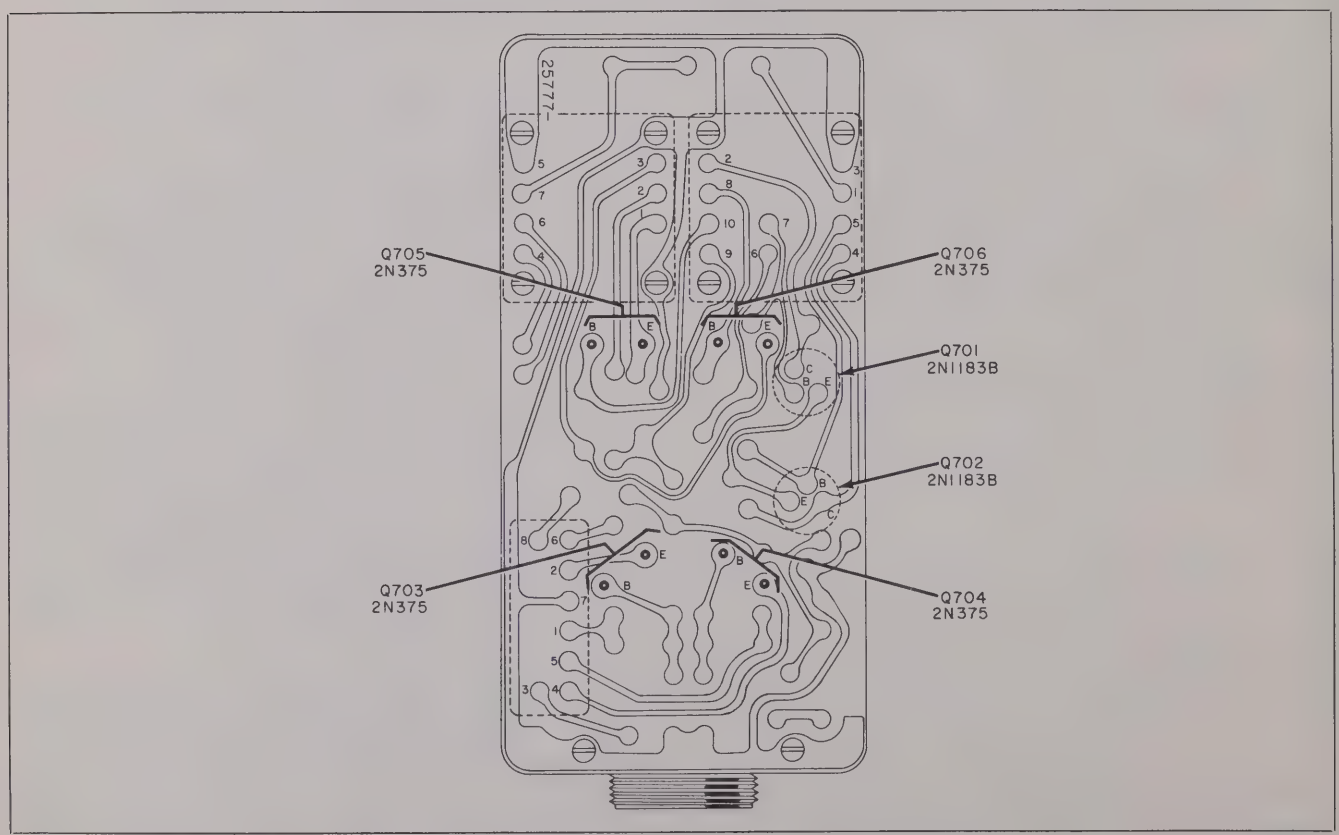


Figure 5–3. DV-14A Dynaverter, Transistor Location Diagram

switch rotor, be sure the rotor is not oriented 180° from its proper position. All switch rotor notches in the receiver r-f assemblies should be on the same side of the flatted shaft, and 150° clockwise from the notch in the rotor of the band selector switch wafer, with all notches viewed from the front of the receiver.

If an assembly has been installed with the rotor improperly oriented, it is not necessary to remove it for realignment of the rotor. Push the shaft through the properly aligned rotors, turn the shaft (by rotating the entire band switch assembly) until the previously engaged rotors agree with the one that is improperly oriented, engage this rotor, and return the shaft to the original angle to engage the remaining rotors.

Replacement of Dynaverter Parts. Most of the Dynaverter parts, such as K701, C709, and C704, can be removed directly from the Dynaverter chassis or printed-circuit board without any further procedure. Other parts, such as T701, T702, and T703, will require removal of the printed-circuit assembly. To remove the printed-circuit assembly, proceed as follows:

Step 1. Remove two binding head screws which secure front end of printed-circuit assembly to chassis frame.

Step 2. Loosen three nuts which fasten C703, C710, and C713 to chassis frame. Bend each capacitor outward, away from its normal position, so that it can be pulled free of its mounting bracket.

Step 3. Disconnect positive lead of C703 from printed-circuit assembly.

Step 4. Remove ten flat head screws fastening T701, T702, and T703 to chassis.

Step 5. Carefully displace printed-circuit assembly and its cabling by swinging assembly upward and outward to left of unit (viewed from front).

If it is necessary to remove T701, T702, or T703 from the printed-circuit board, the heat of a soldering gun (200 watts minimum) should be applied simultaneously to all soldered terminals of the transformer. A special soldering-gun tip is required for this procedure. Use a short length (approximately 4 inches) of No. 10 AWG, or larger, bus wire and form it so that all transformer terminals can be contacted at the same time.

All diodes and transistors Q701 and Q702 in the Dynaverter are soldered in position. The location and polarities of the diodes are shown in Figure 6–16. Figure 5–3 shows the locations and type numbers of the transistors. When soldering or unsoldering a diode lead, hold the lead with pliers between the solder joint and the diode. To remove or replace Q701 or Q702, attach a heat sink between the transistor body and the solder joint (use Mueller Electric Co. No. 88 Universal Clip, or equivalent) to each of the three transistor pins simultaneously and use a formed soldering-gun tip to apply heat simultaneously to the solder joints of the three transistor pins. If a new transistor is used for replacement, remove the black, aluminum radiator from the old transformer and install it on the new transistor before soldering.

Replacement of Control Unit Panel Lamps. The C-59A Control Unit contains two panel lamps that are exposed by unscrewing the appropriate lamp housing on the front panel. Before installing a replacement lamp, check the operating voltage of the lamp against that of the control unit.

The CC-14A and CC-15A Control Units contain three panel lamps which are mounted in grooves in the rear of the front panels. To replace a panel lamp, remove the knobs or cranks, or both, and the front panel of the unit. Then remove the defective lamp from the rear of the front panel. Install new lamp and reassemble the unit.

5–5. PERFORMANCE CHECKS.

General. Table 5–3 outlines the procedures for checking the performance of the ADF set with or without the BTK-21C Bench Test Kit; unless otherwise noted, the procedure applies to either test setup, and all controls, jacks, and indicators referred to in the table are located on ADF Test Panel 19770 (supplied with BTK-21C). The individual checks may be performed separately if desired; however, if a unit has been realigned, all the checks must be performed. The test equipment required for performing the checks is listed in Table 5–1. Figure 5–4 illustrates the bench test setup using a BTK-21C Bench Test Kit. The bench test setup without the BTK-21C is shown in Figure 5–5.

Signal Source. The output of the signal generator is connected either to the SIG IN receptacle on the antenna position simulator or to the input receptacle of the screen room capacitive line divider. When the FUNCTION switch of the antenna position simulator or the screen room capacitive line divider is in the ANT position, the signal generator is fed through a 50-pf capacitor to the 100-pf sense antenna cable assembly. In the LOOP COMP or COMP position, the signal generator is coupled to the sense antenna cable assembly to provide ¼-meter antenna effective height and also to feed one of two wire radiators which supply the signal source to the loop antenna. The spring-loaded BEARING switch of the antenna position simulator determines which wire radiator is used. With the BEARING switch in the normal position, the antenna position simulator provides a 0° bearing; with the BEARING switch held in the TEST position, the antenna position simulator provides a 90° bearing. Since the goniometer-indicator may be internally wired for different loop and sense antenna locations, the goniometer-indicator pointer may not indicate 0° when the receiver function switch is in

the COMP position. Compare the internal wiring of the goniometer-indicator under test to the table in Figure 2–13 to determine the antenna locations for which the goniometer-indicator is wired. The correct pointer indications for the different antenna locations are as follows:

	Top Loop		Bottom Loop	
BEARING Switch	Top Sense	Bottom Sense	Top Sense	Bottom Sense
(Normal)	180°	0°	0°	180°
TEST	90°	270°	90°	270°

The LOOP COMP position of the antenna position simulator FUNCTION switch also provides direct conversion of the signal generator microvolts to microvolts/meter field strength. The COMP position of the capacitive line divider, when used in a calibrated screen room, provides conversion of signal generator microvolts/meter field strength, but the microvolt output of the signal generator must be divided by the "room factor" to obtain the microvolts/meter field strength at the antenna input to the receiver. In the ANT position, the microvolt output of the signal generator is used directly.

Receiver Tuning. For accurate alignment of the receiver, Knob 18802 and Shaft Extension 21330, which are part of the BTK-21C, are desirable. If the tuning knob is not available, the frequency dial of the control unit may be used to select the alignment frequencies, though with less accuracy. The testing of the receiver does not require the use of the tuning knob. The frequency dial on ADF Test Panel 19770 of the BTK-21C or the control unit frequency dial may be used to select the test frequencies. (The test procedures of Table 5–3 are based on the use of the frequency dial.) Table 5–2 lists the number of revolutions of the tuning knob required for specific alignment and test frequencies. The revolutions are counted clockwise from the minimum-capacitance position of the tuning knob.

S+N/N RATIO. All S+N/N ratios are made to produce a 6-db or 10-db S+N/N ratio at 50 mw S+N into a 300-ohm load. The correct reference points for the 6-db ratio are 3.88 volts (50 mw) S+N and 1.94 volts (12.5 mw) N; the 10-db ratio points are 3.88 volts (50 mw) S+N and 1.22 volts (5.0 mw) N.

Audio Output. A 300-ohm resistor must be connected directly across the input terminals of the Ballantine Model 300D voltmeter, or equivalent. Headset or similar equipment connected in parallel with the input of the voltmeter must have a very high impedance, or else be disconnected in order not to affect the audio output measurements.

TABLE 5–2. TUNING KNOB REVOLUTIONS FOR ALIGNMENT AND TEST FREQUENCIES

Band	Frequency (kc)	Use	Revolutions[1]
I	210	Test	24.0 approx.
I	300	Test	12.5 approx.
I	380	Alignment and test	3.58
II	450	Test	23.35 approx.
II	620	Test	13.0 approx.
II	800	Alignment and test	3.58
III	950	Test	23.2 approx.
III	1300	Test	13.1 approx.
III	1650	Alignment and test	4.08

[1]The tuning knob revolutions for alignment frequencies 380, 800, and 1650 kc are the exact number required for accurate alignment of the receiver. The tuning knob revolutions for the test frequencies are approximate because they will vary within the limits of the rated receiver dial accuracy (¼ per cent in frequency).

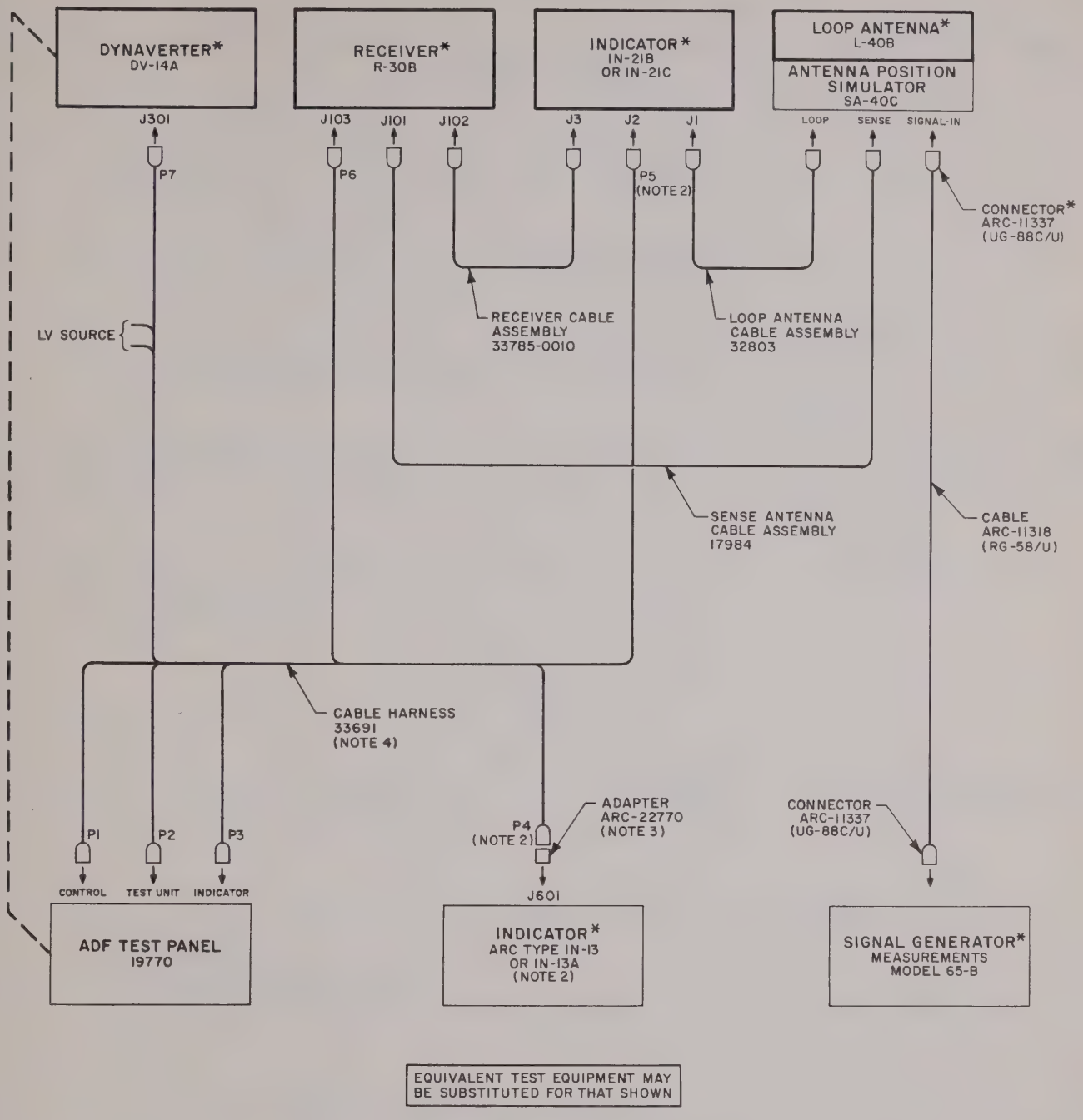
Sensitivity Measurements. MCW ANT sensitivity is defined as the signal input level, modulated 30 percent at 1000 cps, fed in series with a 50-pf capacitance to 100-pf sense antenna cable assembly, required to produce a 6-db S+N/N output ratio at 50 mw S+N (modulation on, modulation off; 50 mw is equal to 3.88 volts across 300 ohms).

MCW LOOP sensitivity is defined as the field strength in microvolts-per-meter (μv/meter) at the loop antenna, modulated 30 percent at 1000 cps and fed through the loop antenna cable assembly, required to produce a 6-db S+N/N output ratio at 50 mw (modulation on, modulation off). For this measurement the goniometer-indicator pointer must be rotated to obtain maximum loop voltage.

CW LOOP sensitivity is defined as the field strength in microvolts-per-meter (μv/meter) at the loop antenna, required to produce a 6-db S+N/N output ratio at 50 mw (carrier on, carrier off). This measurement is made, with the BFO on, by tuning the signal generator to produce a beat-frequency note of about 1000 cps. This note will occur at two points in the vicinity of the receiver r-f tuned frequency; the higher-amplitude note is used for the CW LOOP sensitivity measurement. Also, for this measurement, the goniometer-indicator pointer must be rotated to obtain maximum loop voltage.

CAUTION

In the presence of strong adjacent signals or high ambient noise conditions, the MCW LOOP or CW LOOP sensitivity measurements should be made in a shielded room. The Antenna Position Simulator and cables of the BTK-21C are not perfect shields. Extraneous signals, noise, or both, may affect measurements unless additional shielding is provided. The low-frequency end of Band I (.19–.40) is affected most seriously.



NOTES:

1. PARTS MARKED WITH AN ASTERISK (*) ARE NOT PART OF ARC TYPE BTK-21C BENCH TEST KIT.
2. USED ONLY WHEN TESTING IN-21B.
3. USED ONLY WITH IN-13A.
4. CABLE HARNESS ARC-33893, WHICH HAS PROVISIONS FOR MONITORING INPUT CURRENT, IS AVAILABLE ON SPECIAL ORDER.

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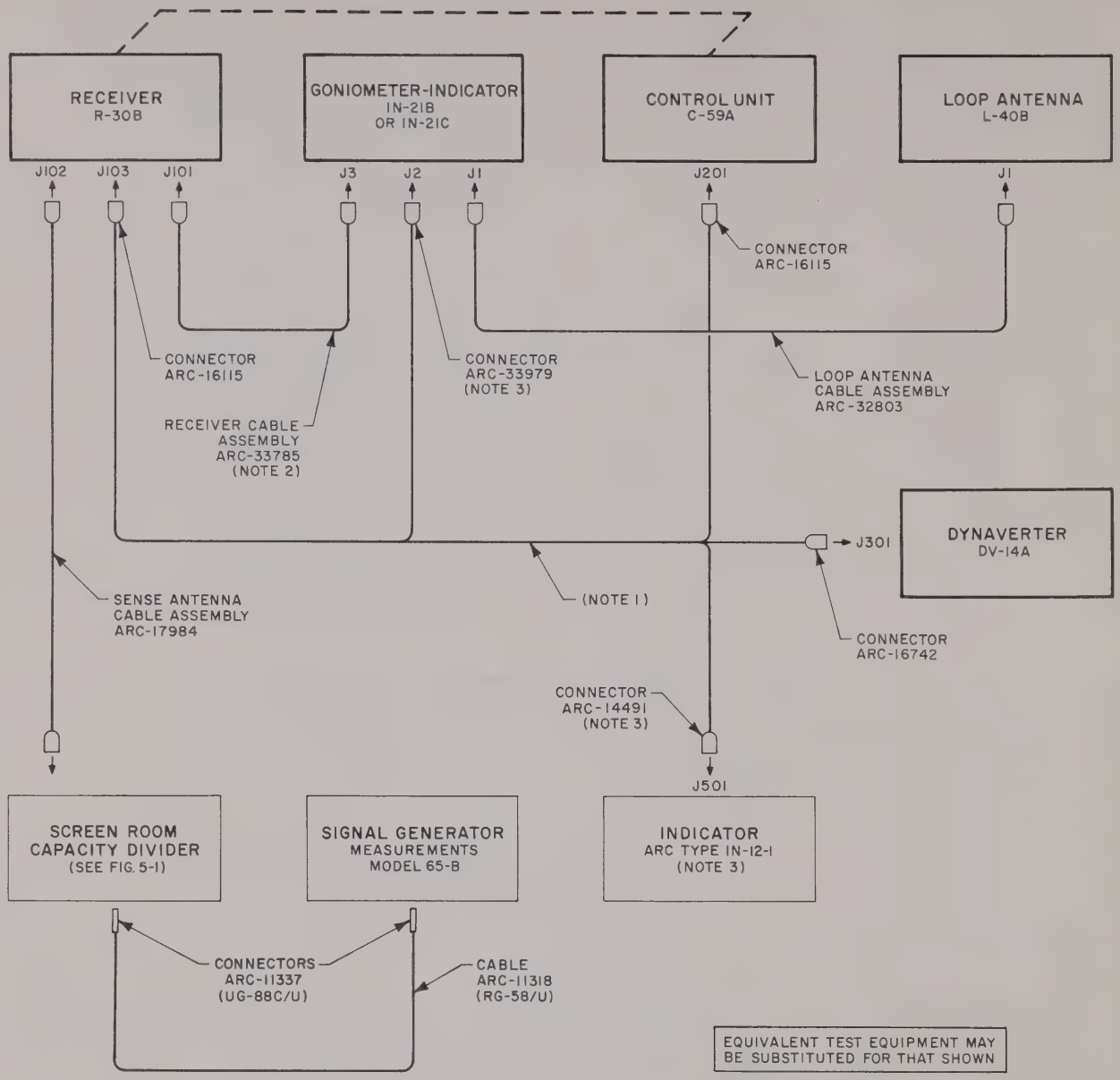
Figure 5–4. Bench Test Interconnection Diagram with ARC Type BTK-21C Bench Test Kit



NOTES:

1. FOR WIRING OF CONNECTORS SEE FIGURE 2-13.
2. CABLE ASSEMBLY 33785 IS SUPPLIED IN ONE OF THREE LENGTHS:
   33875-0010 10 FEET
   33875-0020 20 FEET
   33875-0030 30 FEET
3. USED ONLY WHEN TESTING IN-21B.

TP4359

Figure 5–5. Bench Test Interconnection Diagram without ARC Type BTK-21C Bench Test Kit

TABLE 5–3. EQUIPMENT PERFORMANCE CHECKS

Step	Procedure	Normal Indication
	PRELIMINARY PROCEDURE	
1	*With BTK-21C:* Interconnect units of 21B ADF and test equipment as shown in Figure 5–4. Set antenna position simulator SELECTOR switch to L-40B. *Without BTK-21C:* Interconnect units of 21B ADF and test equipment as shown in Figure 5–5.	None.
2	Rotate tuning crank counterclockwise as far as it will go to bring receiver tuning capacitor to its minimum capacitance position. *Do not force beyond stop.*	None.
3	Disconnect mechanical linkage at either end. Rotate tuning crank until reference line just to right of high frequency end of dial is aligned with fiducial line.	None.
4	Reconnect mechanical linkage taking care not to change setting of tuning capacitor or frequency dial. Recheck positions of tuning capacitor and dial.	The fiducial line and reference line are aligned when tuning capacitor is at minimum capacitance position.
5	Apply primary power to equipment by turning VOL control clockwise. Adjust primary power supply to 13.75 or 27.5 volts dc, depending on voltage rating of equipment. Allow 21B ADF to warm up for at least 30 minutes.	None.
	VOLTAGE AMPLITUDE AND FREQUENCY	
1	Perform preliminary procedure outlined in this table.	None.
2	*With BTK-21C:* Set meter switch to LV and function switch to COMP. *Without BTK-21C:* Set control unit function switch to COMP. Connect Hewlett-Packard Model 410B voltmeter between terminal A of J103 on receiver and ground.	Meter reads 13.75 or 27.5 volts dc, depending on voltage rating of equipment.
3	*With BTK-21C:* Set meter switch to HV1. *Without BTK-21C:* Connect 410B between terminal B of J103 on receiver and ground.	Meter reads between 118 and 150 volts dc (14-volt unit) or 122 and 140 volts dc (28-volt unit).
4	*With BTK-21C:* Set meter switch to HV2. *Without BTK-21C:* Connect 210B between terminal C of J103 on receiver and ground.	Meter reads between 102 and 115 volts dc (14-volt unit) or 108 and 120 volts dc (28-volt unit).
5	*With BTK-21C:* Set meter switch to 100~. *Without BTK-21C:* Connect 0–50 volt ac meter (rectifier type) between terminal I of J103 on receiver and ground.	Meter reads between 12.0 and 14.5 volts ac (14-volt unit) or 12.5 and 15.0 volts ac (28-volt unit).
6	*With BTK-21C:* Connect 0–50 volt ac meter (rectifier type) between GRD and ϕ2 jacks. Throw LOOP switch right or left to rotate goniometer-indicator pointer. *Without BTK-21C:* Connect 0–50 volt ac meter (rectifier type) between terminal B of J2 on goniometer-indicator and ground. Throw LOOP switch right or left to rotate goniometer-indicator pointer.	Meter reads approximately 40 volts ac.
7	*With BTK-21C:* Observe frequency meter. *Without BTK-21C:* Connect 94–116 cps, 10–15 volt frequency meter between terminal I of J103 on receiver and ground.	Frequency meter reads between 97 and 103 cps.

TABLE 5–3. EQUIPMENT PERFORMANCE CHECKS — Continued

Step	Procedure	Normal Indication
	BANDSWITCH OPERATION	
1	Perform preliminary procedure outlined in this table.	None.
2	*With BTK-21C:* Set meter switch to LV. Adjust primary voltage to 11.0 volts dc (14-volt unit) or 22.0 volts dc (28-volt unit), as read on voltmeter. Check operation of MC BAND switch in all positions. *Without BTK-21C:* Connect Hewlett-Packard Model 410B voltmeter between terminal A of J103 on receiver and ground. Adjust primary voltage to 11.0 volts dc (14-volt unit) or 22.0 volts dc (28-volt unit), as read on 410B. Check operation of control unit MC BAND switch in all positions.	Bandswitch operates correctly but with reduced speed.
3	Repeat Step 2, adjusting primary voltage to 15.5 volts dc (14-volt unit) or 31.0 volts dc (28-volt unit), as read on voltmeter.	Bandswitch operates properly but at higher speed and with no tendency to overshoot.
	MINIMUM NOISE LEVEL	
1	Perform preliminary procedure outlined in this table.	None.
2	*With BTK-21C:* Connect Ballantine Model 300D voltmeter, with 300-ohm resistance across input, to either TEL jack. *Without BTK-21C:* Connect Ballantine Model 300D voltmeter, with 300-ohm resistance across input, between terminal J of J103 on receiver and ground.	None.
3	*With BTK-21C:* Set meter switch to TEL JKS position, function switch to ANT position, and VOL control to extreme counterclockwise (minimum) position. *Without BTK-21C:* Set control unit function switch to ANT position and VOL control to extreme counterclockwise (minimum) position.	Meter reads less than 4 mv (equivalent to 0.005 mw).
	MCW ANT SENSITIVITY	
1	Perform preliminary procedure outlined in this table.	None.
2	*With BTK-21C:* Connect Ballantine Model 300D voltmeter, with 300-ohm resistor across input, to either TEL jack. *Without BTK-21C:* Connect Ballantine Model 300D voltmeter, with 300-ohm resistor across input, between terminal J of J103 on receiver and ground.	None.
3	*With BTK-21C:* Set meter switch to TEL JKS, function switch to ANT, BFO switch off, MC BAND switch to Band I (.19–.40), and antenna position simulator FUNCTION switch to ANT. *Without BTK-21C:* Set screen room and control unit function switch to ANT. Set control unit BFO switch off and MC BAND switch to Band I (.19–.40).	None.
4	Tune receiver to 380 kc.	None.
5	Set Measurements Model 65-B Signal Generator output to 10 μv modulated 30 per cent, 1000 cps.	None.
6	Tune 65-B in vicinity of 380 kc for maximum audio output as indicated on voltmeter and simultaneously adjust VOL control to produce 3.88 volts output.	None.
7	Turn modulation off and read voltmeter.	If voltmeter reading (output) is more than 6 db below 3.88 volts (less than 1.94 volts), sensitivity is better than 10 μv.

TABLE 5–3. EQUIPMENT PERFORMANCE CHECKS — Continued

Step	Procedure	Normal Indication
	MCW ANT SENSITIVITY — Continued	
8	Set MC BAND switch to Band II (.40–.84). *Do not change tuning of receiver.* Repeat Steps 5, 6, and 7, except tune 65-B in vicinity of 800 kc to measure sensitivity at 800 kc.	As noted in Step 7.
9	Set MC BAND switch to Band III (.84–1.75) and tune receiver to 1650 kc.	None.
10	Repeat Steps 5, 6, and 7, except tune 65-B in vicinity of 1650 kc to measure sensitivity at 1650 kc.	As noted in Step 7.
11	Set MC BAND switch to Band I (.19–.40) and tune receiver to 300 kc.	None.
12	Repeat Steps 5, 6, and 7, except tune 65-B in vicinity of 300 kc to measure sensitivity at 300 kc.	As noted in Step 7.
13	Set MC BAND switch to Band II (.40–.84) and tune receiver to 620 kc.	None.
14	Repeat Steps 5, 6, and 7, except tune 65-B in vicinity of 620 kc to measure sensitivity at 620 kc.	As noted in Step 7.
15	Set MC BAND switch to Band III (.84–1.75) and tune receiver to 1300 kc.	None.
16	Repeat Steps 5, 6, and 7, except tune 65-B in vicinity of 1300 kc to measure sensitivity at 1300 kc.	As noted in Step 7.
17	Set MC BAND switch to Band I (.19–.40) and tune receiver to 210 kc.	None.
18	Repeat Steps 5, 6, and 7, except tune 65-B in vicinity of 210 kc to measure sensitivity at 210 kc.	As noted in Step 7.
19	Set MC BAND switch to Band II (.40–.84) and tune receiver to 450 kc.	None.
20	Repeat Steps 5, 6, and 7, except tune 65-B in vicinity of 450 kc to measure sensitivity at 450 kc.	As noted in Step 7.
21	Set MC BAND switch to Band III (.84–1.75) and tune receiver to 950 kc.	None.
22	Repeat Steps 5, 6, and 7, except tune 65-B in vicinity of 950 kc to measure sensitivity at 950 kc.	As noted in Step 7.
	MCW LOOP SENSITIVITY	
1	Perform preliminary procedure outlined in this table.	None.
2	*With BTK-21C:* Connect Ballantine Model 300D voltmeter, with 300-ohm resistor across input, to either TEL jack. Set meter switch to TEL JKS. *Without BTK-21C:* Connect Ballantine Model 300D voltmeter, with 300-ohm resistor across input, between terminal J of J103 on receiver and ground.	None.
3	*With BTK-21C:* Set function switch to LOOP, MC BAND switch to Band I (.19–.40) and antenna position simulator FUNCTION switch to LOOP COMP. Set LOOP MOTOR switch to ON, press LOOP switch to rotate goniometer-indicator pointer to either 90° or 270° as read on dial with 0° position aligned with index at top of goniometer-indicator. Release LOOP switch. Set LOOP MOTOR switch off. Set BFO switch off. *Without BTK-21C:* Set screen room function switch to COMP. Set function switches to LOOP. Set control unit MC BAND switch to Band I (.19–.40), and BFO switch off. Press LOOP switch to rotate goniometer-indicator pointer for maximum audio output as indicated on 300D. Release LOOP switch.	None.

TABLE 5–3. EQUIPMENT PERFORMANCE CHECKS — Continued

Step	Procedure	Normal Indication
	MCW LOOP SENSITIVITY — Continued	
4	Tune receiver to 210 kc.	None.
5	Set Measurements Model 65-B Signal Generator to 100 μv, modulated 30 per cent at 1000 cps.	None.
6	Tune 65-B in vicinity of 210 kc for maximum audio output as indicated on 300D and simultaneously adjust VOL control to produce 3.88 volts output.	None.
7	Turn modulation off and read 300D.	If voltmeter reading (output) is more than 6 db below 3.88 volts (less than 1.94 volts) sensitivity is better than 250 μv. **Note** Extraneous signals or noise will affect this measurement. Be sure area in which measurement is made is properly shielded.
	CW LOOP SENSITIVITY	
1	Perform preliminary procedure outlined in this table.	None.
2	*With BTK-21C:* Connect Ballantine Model 300D voltmeter, with 300-ohm resistor across input, to either TEL jack. Set meter switch to TEL JKS. *Without BTK-21C:* Connect Ballantine Model 300D voltmeter, with 300-ohm resistor across input, between terminal J of J103 on receiver and ground.	None.
3	*With BTK-21C:* Set function switch to LOOP, MC BAND switch to Band I (.19–.40) and antenna position simulator FUNCTION switch to LOOP COMP. Set LOOP MOTOR switch to ON, press LOOP switch to rotate goniometer-indicator pointer to either 90° or 270° as read by goniometer-indicator pointer with dial 0° position aligned with index at top of goniometer-indicator. Release LOOP switch. Set LOOP MOTOR switch off. Set BFO switch to ON. *Without BTK-21C:* Set screen room function switch to COMP. Set control unit function switch to LOOP, MC BAND switch to Band I (.19–.40), and BFO switch off. Press LOOP switch to rotate goniometer-indicator pointer for maximum audio output as indicated on 300D. Release LOOP switch.	None.
4	Tune receiver to 380 kc.	None.
5	Set Measurements Model 65-B Signal Generator output to 70 μv (modulation off). Tune 65-B in vicinity of 380 kc for maximum output as indicated on 300D and simultaneously adjust VOL control for 3.88 volts.	None.
6	Turn carrier off and read Model 300D.	If voltmeter reading (output) is more than 6 db below 3.88 volts (less than 1.94 volts), sensitivity is better than 70 μv/meter.
7	Set MC BAND switch to Band II (.40–.84). *Do not change tuning of receiver.* Repeat Steps 5 and 6 except tune 65-B in vicinity of 800 kc to measure sensitivity at 800 kc.	As noted in Step 6.
8	Set MC BAND switch to Band III (.84–1.75) and tune receiver to 1650 kc.	None.

TABLE 5–3. EQUIPMENT PERFORMANCE CHECKS — Continued

Step	Procedure	Normal Indication
	CW LOOP SENSITIVITY — Continued	
9	Repeat Steps 5 and 6, except tune 65-B in vicinity of 1650 kc to measure sensitivity at 1650 kc.	As noted in Step 6.
10	Set MC BAND switch to Band I (.19–.40) and tune receiver to 210 kc.	None.
11	Set 65-B output to 100 μv (modulation off). Tune 65-B in vicinity of 210 kc for maximum audio output as indicated on 300D and simultaneously adjust VOL control to produce 3.88 volts output.	None.
12	Turn carrier off and read Model 300D.	If voltmeter reading (output) is more than 6 db below 3.88 volts (less than 1.94 volts), sensitivity is better than 100 μv.
13	Set MC BAND switch to Band II (.40–.84) and tune receiver to 450 kc.	None.
14	Repeat Steps 11 and 12, except set 65-B output to 70 μv and tune 65-B in vicinity of 450 kc to measure sensitivity at 450 kc.	As noted in Step 12, except sensitivity is better than 70 μv.
15	Set MC BAND switch to Band III (.84–1.75) and tune receiver to 950 kc.	None.
16	Repeat Steps 11 and 12, except set 65-B output to 70 μv and tune 65-B in vicinity of 950 kc, to measure sensitivity at 950 kc.	As noted in Step 12, except sensitivity is better than 70 μv.
	COMPASS SENSITIVITY	
1	Perform preliminary procedure outlined in this table.	None.
2	Set MC BAND switch to Band I (.19–.40) and tune receiver to 210 kc approximately.	None.
3	*With BTK-21C:* Set function switch to COMP, BFO switch off, and LOOP MOTOR switch to ON. Set antenna position simulator FUNCTION switch to LOOP COMP. *Without BTK-21C:* Set screen room and control unit function switches to COMP. Set control unit BFO switch off.	None.
4	Set Measurements Model 65-B Signal Generator output to 10,000 μv (that is, 10,000 μv/meter field strength), with no modulation.	None.
5	Tune 65-B in vicinity of 210 kc for maximum tuning meter deflection.	Pointer nulls.
6	Rotate goniometer-indicator VAR. knob until pointer is at dial 0° position.	Dial 0° position and pointer may not be aligned with index at top of goniometer-indicator if loop compensation schedule has been set up.
7	Set 65-B output to 60 μv (that is, 60 μv/meter field strength) with no modulation and tune 65-B in vicinity of 210 kc for maximum tuning deflection.	Goniometer-indicator reads 0±2° with ±2° jitter.
8	Set 65-B output to 10,000 μv. Note average reading and jitter of indicator.	Goniometer-indicator reads 0±1° with ±½° jitter.
9	Set 65-B output to 60 μv. Press LOOP switch to rotate goniometer-indicator pointer 175° clockwise from null. Release LOOP switch and note time (in seconds) required for pointer to return within 2° of null.	Goniometer-indicator pointer returns in 9 seconds or less. **Note** If goniometer-indicator has been compensated, pointer may slow down, speed up, or both, while pointer is traveling toward zero. This indication is normal.

TABLE 5–3. EQUIPMENT PERFORMANCE CHECKS — Continued

Step	Procedure	Normal Indication
	COMPASS SENSITIVITY — Continued	
10	Set MC BAND switch to Band II (.40–.84) and tune receiver to 450 kc. Repeat Steps 7, 8, and 9, except tune 65-B in vicinity of 450 kc.	As noted in Steps 7, 8, and 9.
11	Set MC BAND switch to Band III (.84–1.75) and tune receiver to 950 kc. Repeat Steps 7, 8, and 9, except tune 65-B in vicinity of 950 kc.	As noted in Steps 7, 8, and 9.
12	Set MC BAND switch to Band I (.19–.40) and tune receiver to 380 kc. Repeat Steps 7, 8, and 9, except tune 65-B in vicinity of 380 kc.	As noted in Steps 7, 8, and 9.
13	Set MC BAND switch to Band II (.40–.84). *Do not change tuning of receiver.* Repeat Steps 7, 8, and 9, except tune 65-B in vicinity of 800 kc.	As noted in Steps 7, 8, and 9.
14	Set MC BAND switch to Band III (.84–1.75) and tune receiver to 1650 kc. Repeat Steps 7, 8, and 9, except tune 65-B in vicinity of 1650 kc.	As noted in Steps 7, 8, and 9.
	AVC TEST	
1	Perform preliminary procedure outlined in this table.	None.
2	*With BTK-21C:* Connect Ballantine Model 300D voltmeter, with 300-ohm resistor across input, to either TEL jack. Set meter switch to TEL JKS. *Without BTK-21C:* Connect Ballantine Model 300D voltmeter, with 300-ohm resistor across input, between terminal J of J103 on receiver and ground.	None.
3	Set MC BAND switch to Band I (.19–.40) and tune receiver to 210 kc.	None.
4	*With BTK-21C:* Set function switch to COMP, BFO switch to off, and antenna position simulator FUNCTION switch to ANT. *Without BTK-21C:* Set screen room and control unit function switches to ANT. Set control unit BFO switch off.	None.
5	Set Measurements Model 65-B Signal Generator output to 100 μv, modulated 30 per cent at 1000 cps.	None.
6	Tune 65-B in vicinity of 210 kc for maximum tuning meter deflection and simultaneously adjust VOL control to produce 3.88 volts output as indicated on 300D.	None.
7	Set 65-B output to 10 μv.	Voltmeter reads between 2.0 and 4.8 volts.
8	Set 65-B output to 100 μv.	Voltmeter reads between 3.8 and 4.0 volts.
9	Set 65-B output to 100,000 μv.	Voltmeter reads between 4.2 and 6.8 volts.
10	Set 65-B output to 500,000 μv.	Voltmeter reads 8.5 volts or less.
11	Set MC BAND switch to Band II (.40–.84) and tune receiver to 450 kc.	None.
12	Repeat Steps 4 through 10, except tune 65-B in vicinity of 450 kc.	As noted in Steps 4 through 10.
13	Set MC BAND switch to Band III (.84–1.75) and tune receiver to 950 kc.	None.
14	Repeat Steps 4 through 10, except tune 65-B in vicinity of 950 kc.	As noted in Steps 4 through 10.
	POWER OUTPUT TEST	
1	Perform preliminary procedure outlined in this table.	None.
2	*With BTK-21C:* Connect Ballantine Model 300D voltmeter, with 300-ohm resistor across input, to either TEL jack. Set meter switch to TEL JKS.	None.

TABLE 5–3. EQUIPMENT PERFORMANCE CHECKS — Continued

Step	Procedure	Normal Indication
	POWER OUTPUT TEST — Continued	
2	*Without BTK-21C:* Connect Ballantine Model 300D voltmeter, with 300-ohm resistor across input, between terminal J of J103 on receiver and ground.	
3	*With BTK-21C:* Set MC BAND switch to Band III (.84–1.75) and tune receiver to 950 kc. Set antenna position simulator FUNCTION switch to ANT. *Without BTK-21C:* Set screen room and control unit function switches to ANT. Set control unit BFO switch to off and MC BAND switch to Band III (.84–1.75). Tune receiver to 950 kc.	None.
4	Set Measurements Model 65-B Signal Generator output to 100 μv, modulated 30 per cent at 1000 cps and tune 65-B in vicinity of 950 kc for maximum tuning meter deflection.	None.
5	Set VOL control to extreme clockwise position and note audio output as indicated by Model 300D.	Voltmeter reads between 10 and 15 volts.
	LOW-VOLTAGE OPERATION	
1	Perform preliminary procedure outlined in this table.	None.
2	*With BTK-21C:* Connect Ballantine Model 300D voltmeter, with 300-ohm resistor across input, to either TEL jack. Set meter switch to TEL JKS. *Without BTK-21C:* Connect Ballantine Model 300D voltmeter, with 300-ohm resistor across input, between terminal J of J103 on receiver and ground.	None.
3	Set MC BAND switch to Band I (.19–.40) and tune receiver to 210 kc.	None.
4	*With BTK-21C:* Set function switch to ANT, BFO switch to off, and antenna position simulator FUNCTION switch to ANT. Adjust primary voltage to 11.0 volts dc (14-volt unit) or 22.0 volts dc (28-volt unit). *Without BTK-21C:* Set screen room and control unit function switches to ANT. Set control unit BFO switch to off. Adjust primary voltage to 11.0 volts dc (14-volt unit) or 22.0 volts dc (28-volt unit).	None.
5	Set Measurements Model 65-B Signal Generator output to 10 μv, modulated 30 per cent at 1000 cps.	None.
6	Tune 65-B in vicinity of 210 kc for maximum audio output as indicated on 300D and simultaneously adjust VOL control to produce 2.0 volts.	None.
7	Turn modulation off and read 300D.	Voltmeter reads 1.0 volt or less.
8	Set BFO switch to ON. Check that BFO operates.	Voltmeter reading increases indicating BFO is operating. (May be checked aurally by connecting headset.)
9	Set BFO switch to off. Set MC BAND switch to Band II (.40–.84) and tune receiver to 450 kc.	None.
10	Repeat Steps 5, 6, and 7, except tune 65-B in vicinity of 450 kc.	As noted in Step 7.
11	Set MC BAND switch to Band III (.84–1.75) and tune receiver to 950 kc.	None.
12	Repeat Steps 5, 6, and 7, except tune 65-B in vicinity of 950 kc.	As noted in Step 7.

5–6. TROUBLE ANALYSIS.

Table 5–4 is a trouble analysis chart supplied as an aid in localizing trouble to a particular unit and, in some cases, to a particular circuit or part. The analysis procedures described are based on trouble-shooting the equipment while installed in the aircraft, though they may also be used when bench-testing the equipment. Units causing equipment failure may also be localized by substituting a reliable unit. If the fault cannot be corrected with the equipment installed in the aircraft, either the suspected units or the complete equipment may be removed for a bench test. If a bench test is required, use of the BTK-21C Bench Test Kit will be helpful.

Note

Do not remove the loop antenna from the aircraft unless absolutely necessary.

TABLE 5–4. TROUBLE ANALYSIS CHART

Symptom	*Probable Trouble*	*Analysis Procedure*
Goniometer-indicator pointer shows station bearing on one or two bands only during COMP operation. (Pointer rotates normally when LOOP switch is operated.)	Failure in r-f section of receiver.	Remove receiver for bench test. Make stage gain measurements (refer to Table 5–6).
Goniometer-indicator pointer does not show station bearing on any band, or rotates to station bearing too slowly during COMP operation. (Pointer rotates normally when LOOP switch is operated.	Poor sensitivity.	Tune receiver to a known weak station and check sensitivity of reception during ANT and LOOP operation. Localize trouble as follows:
	a. Failure in r-f or i-f section of receiver.	*a.* If sensitivity is poor for both ANT and LOOP operation, remove receiver for bench test. Make stage gain measurements (refer to Table 5–6).
	b. Cable assemblies opened or shorted, or braided shield damaged. Failure in receiver loop amplifier Z101 or modulator Z102. Defective loop antenna or goniometer-indicator.	*b.* If sensitivity is normal for ANT but poor for LOOP operation, check loop antenna cable assembly, receiver cable assembly, and component parts of Z101 and Z102.
	c. Defective sense antenna cable assembly or sense antenna.	*c.* If sensitivity is normal for LOOP but poor for ANT operation, check sense antenna cable assembly for open or short; check condition and installation of sense antenna.
	d. Failure in control unit or defective interconnecting wiring.	*d.* If sensitivity is normal for both ANT and LOOP operation, check condition and operation of control unit function switch. Make continuity check of interconnecting wiring (see Figure 2–13).
Goniometer-indicator pointer does not rotate. (Receiver sensitivity normal during ANT operation.)	Defective interconnecting wiring.	Check continuity of interconnecting wiring (see Figure 2–13).
	Defective function switch in control unit.	Set function switch to COMP. Remove connector from control unit. With ohmmeter, check that terminal B of J201 is connected to ground; if not grounded, switch is defective.

TABLE 5–4. TROUBLE ANALYSIS CHART — Continued

Symptom	Probable Trouble	Analysis Procedure
Goniometer-indicator pointer does not rotate. (Receiver sensitivity normal during ANT operation.) (Continued)	Incorrect a-c output from Dynaverter.	Remove receiver dust cover. Measure value and frequency of 100-cps voltage between terminal I of J103 and ground; should be 13 ±1 volts ac, 100 ±3 cps.
	Servo amplifiers in receiver or output transformer T704 in Dynaverter defective.	Make continuity check of T704. Make stage gain measurements of servo amplifiers (refer to Table 5–7).
	Defective motor or gear train in goniometer-indicator.	Make resistance measurements of goniometer-indicator (refer to Table 5–9).
	Defective loop antenna.	Temporarily connect (do not install) loop antenna known to be good in place of installed loop antenna. If substitute loop antenna provides normal rotation of goniometer-indicator pointer, replace installed loop antenna.
Goniometer-indicator pointer rotates to station bearing too slowly during COMP operation, and also when LOOP switch is operated.	Incorrect a-c output from Dynaverter.	Remove receiver dust cover. Measure value and frequency of 100-cps voltage between terminal I of J103 and ground; should be 13 ±1 volts ac, 100 ±3 cps.
	Failure of servo amplifiers in receiver.	Remove receiver for bench test. Make stage gain measurements of servo amplifiers (refer to Table 5–7).
	Defective interconnecting wiring.	Check continuity of interconnecting wiring (see Figure 2–13).
	Defective goniometer-indicator motor or gear train.	Make resistance measurements of goniometer-indicator (refer to Table 5–9).
Goniometer-indicator pointer rotates too rapidly with no signal input (drift greater than 180° in 30 seconds).	Modulator Z102 in receiver unbalanced.	Adjust R108 (refer to *Balanced Modulator Adjustment* in Table 5–5).
	Excessive noise from loop antenna cable assembly or receiver cable assembly.	Disconnect receiver cable assembly at receiver. If rotation speed is reduced significantly, trouble is in loop antenna, receiver and loop antenna cable assemblies or goniometer in goniometer-indicator.
	Defective V102 or associated circuit components of Z102 in receiver.	Remove receiver for bench test.
Noisy reception.	Interference from outside source.	Shut off aircraft engines and all other equipment except 21B ADF. Check reception.
	Poor ground connections.	Check all ground connections. Check ground straps on receiver and Dynaverter mountings.
	Defective sense antenna.	Check receiver reception in ANT position of known weak signal.
	Defective loop antenna, loop antenna cable assembly, or goniometer in goniometer-indicator.	Check receiver reception of known weak station in LOOP position.
	Faulty receiver or Dynaverter.	Remove receiver or Dynaverter for bench test.

TABLE 5–4. TROUBLE ANALYSIS CHART — Continued

Symptom	*Probable Trouble*	*Analysis Procedure*
Receiver fails to switch bands in any one or all positions of MC BAND switch.	Defective motor or gear train in band selector, Z110, in receiver.	Set MC BAND switch successively to Bands I, II, and III. Check if voltage exists across terminals of motor B101. If voltage exists, motor or gear train is defective. If voltage does not exist, check other probable troubles.
	Common terminal of MC BAND switch S203 in control unit not grounded.	Make continuity check from terminal C of J201 to ground.
	Failure of MC BAND switch S203 in control unit, or defective interconnecting wiring.	Disconnect plug from J103 of receiver. Make continuity check from plug terminals F, G, and H to ground, with MC BAND switch in Band I, II, and III positions, respectively.
	Band selector Z110 in receiver defective.	If previous test procedures indicated no voltage across motor terminals, and proper continuity at terminals F, G, and H of plug connected to J103, check K101, S107, and S108 of Z110 in receiver.
Receiver switches bands continually with MC BAND switch in any position.	Contacts of K101 (normally closed) in receiver not making positive contact.	Burnish and adjust contacts of K101. Check bandswitch operation (refer to Step 2 of *Bandswitch Operation* in Table 5–3).
	Cam follower arm of S107 in receiver rides beyond bottom of cam notch.	Adjust S107 so that switch opens just before cam follower arm reaches bottom of cam notch. Check bandswitch operation (refer to Step 2 of *Bandswitch Operation* in Table 5–3).
	Two interconnecting wires to band selector Z110 in receiver shorted to ground.	Disconnect plugs from J103 of receiver and J201 of control unit. Make continuity check from plug terminals F, G, and H to ground with MC BAND switch in Band I, II, and III positions, respectively.
	Two switch contacts of S108 in receiver or S203 in control unit shorted to ground.	Check visually and make continuity check.
	Defective S107 of Z110 in receiver.	Check visually and make continuity check.
Receiver switches bands continuously with MC BAND switch in any two of the three bands.	Interconnecting wire of one band shorted to ground.	Disconnect plugs J103 of receiver and J201 of control unit. Make continuity check of interconnecting wires. (Band not switching continually has shorted lead.)
	Contact of S108 in receiver or S203 in control unit shorted to ground.	Check visually and make continuity check.
	Two of three band selector interconnecting wires shorted to each other.	Disconnect plugs from J103 of receiver and J201 of control unit. Make continuity check of interconnecting wires. (Band which does not continually switch is normal; short is between remaining two bands.)
	Two switch contacts of S108 in receiver or S103 in control unit shorted to each other.	Check visually and make continuity check.

TABLE 5–4. TROUBLE ANALYSIS CHART — Continued

Symptom	*Probable Trouble*	*Analysis Procedure*
Goniometer-indicator pointer indicates 180° from correct station bearing. **Note** Erroneous directional information may be given during checks on the ground due to reflections from nearby buildings, power lines, etc. Make suitable flight checks to be sure trouble actually exists.	Defective or incorrect wiring between loop antenna and goniometer-indicator.	Check interconnecting wiring (see Figure 2–13).
	Terminal 3 of Z105 shorted to ground.	*With ohmmeter positive probe grounded,* check that resistance of avc bus to ground is at least 100,000 ohms. Make this measurement with receiver cold.
	Defective loop transformer (T101, T102, or T103) or defective antenna transformer (T105, T106, or T107) in receiver.	If fault occurs on one band only, loop or antenna transformer of that band probably defective; remove receiver for bench test.
	Incorrect a-c output of Dynaverter.	Remove receiver dust cover. Measure value and frequency of 100-cps voltage between terminal I of J103 and ground; should be 13 ±1 volts ac, 100 ±3 cps.
In COMP position, goniometer-indicator pointer moves left when aircraft is turned left, and right when aircraft is turned right.	Incorrect interconnecting wiring (see Figure 2–13).	Check continuity of interconnecting wiring (see Figure 2–13).
No audio output; equipment functions normally otherwise.	Audio cut off because of band-switching failure.	Check operation of MC BAND switch and switching mechanism.
	Defective audio volume control.	Measure resistance between terminals O and E of J201 in control unit. Resistance should vary from 0 to 100,000 ohms as VOL control is varied from maximum clockwise to maximum counterclockwise positions.
	Defective interconnecting wire.	Check continuity of interconnecting wiring (see Figure 2–13).
	Defective receiver.	Remove receiver for bench test.
ADF set inoperative in all functions including failure to switch bands.	No low voltage supplied to Dynaverter.	With primary power on, determine whether Dynaverter is operating. If not, check low-voltage input.
	Failure in Dynaverter.	Remove Dynaverter for bench test (see Table 5–8).
	No primary voltage to receiver.	With primary power on, check primary power input to receiver.
	Defective interconnecting wiring.	Check continuity of interconnecting wiring (see Figure 2–13).
	Defective receiver.	Remove receiver for bench test.
ADF set inoperative except in COMP operation.	Defective r-f sensitivity control R201A in control unit.	Remove rear cover from control unit. Measure resistance of R201A.
	Defective interconnecting wiring.	Check continuity of interconnecting wiring (see Figure 2–13).

5–7. ALIGNMENT AND ADJUSTMENT.

Receiver. Table 5–5 outlines the procedure for aligning the receiver. Though specific alignment procedures are identified by subtitles, they should not be performed individually; each procedure presupposes that all previous steps have been completed. The test equipment and accessories required for alignment and adjustment are listed in Table 5–1. The bench test setup using a BTK-21C Bench Test Kit is shown in Figure 5–4. The bench test setup without the BTK-21C is shown in Figure 5–5. The alignment points referred to in the table are shown in Figure 5–6. The standard test conditions described in paragraph 5–5 apply. Unless otherwise noted, all controls and indicators referred to in the table are located on the ADF Test Panel 19770 (supplied with the BTK-21C).

Note

The receiver is aligned at the factory. Do not realign unless it is evident such action is required. If a unit is realigned, all the test procedures of Table 5–6 must be performed to check the accuracy of alignment.

TABLE 5–5. RECEIVER ALIGNMENT

Step	Procedure
	PRELIMINARY PROCEDURE
1	*With BTK-21C:* Interconnect equipment as shown in Figure 5–4. *Without BTK-21C:* Interconnect equipment as shown in Figure 5–5.
2	*With BTK-21C:* Fit Shaft Extension 21330 over spline shaft of receiver tuning capacitor and tighten. Install Knob 18802 over shaft extension. Rotate tuning knob counterclockwise until it stops—*do not force beyond stop.* *Without BTK-21C:* Rotate control unit tuning crank counterclockwise as far as it will go to bring receiver tuning capacitor to its minimum capacitance position. *Do not force beyond stop.*
3	*With BTK-21C:* Without disturbing receiver tuning capacitor setting, remove tuning knob. Orient tuning knob until red zero line is approximately on top (12 o'clock position). Replace tuning knob. *Without BTK-21C:* Disconnect mechanical linkage at either end. Rotate tuning crank until reference line just to right of high-frequency end of dial is aligned with fiducial line.
4	*With BTK-21C:* Hold tuning knob so that red zero is still on top and receiver tuning capacitor does not change position, then tighten tuning knob knurled nut. Rotate collar on tuning knob until black fiducial line is aligned with zero line. **Note** Refer to Table 5–2 for a listing of tuning knob revolutions for receiver alignment frequencies. *Without BTK-21C:* Reconnect mechanical linkage taking care not to change setting of tuning capacitor or frequency dial. Recheck positions of tuning capacitor and dial.
5	Apply power to equipment by turning VOL control clockwise. Adjust primary power supply to 13.75 or 27.5 volts dc, depending on voltage rating of equipment. Allow equipment to warm up for at least 30 minutes.
	TRIMMER CAPACITOR ALIGNMENT
6	Set Measurements Model 65-B Signal Generator to exactly 380 kc. Use Measurements Model 111-B Crystal Calibrator to check frequency.
7	*With BTK-21C:* Set function switch to COMP, MC BAND switch to Band I (.19–.40), and LOOP MOTOR ON-OFF switch to OFF. Set antenna position simulator SELECTOR switch to L-40B. *Without BTK-21C:* Set screen room and control unit function switches to COMP. Set control unit MC BAND switch to Band I (.19–.40) and BFO switch to OFF.
8	*With BTK-21C:* Rotate tuning knob 3.58 revolutions clockwise. **Note** To reduce effects of backlash, rotate tuning knob in counterclockwise direction to approach frequency setting. *Without BTK-21C:* Tune receiver to 380 kc. **Note** To reduce effects of mechanical linkage backlash, rotate tuning crank in counterclockwise direction to approach frequency setting.

TABLE 5–5. RECEIVER ALIGNMENT — Continued

Step	Procedure
	TRIMMER CAPACITOR ALIGNMENT — Continued
9	Set 65-B output to approximately 10,000 μv. Adjust Band I OSC trimmer C141, then 2nd RF trimmer C130, then 1st RF trimmer C125, and finally ANT trimmer C119 for maximum deflection of tuning meter.
10	Set 65-B output to approximately 20 μv. Repeat adjustment of C141, C130, C125, and C119 for maximum deflection of tuning meter.
11	Set 65-B to exactly 800 kc. Set MC BAND switch to Band II (.40–.84). *Do not change tuning of receiver.*
12	Set 65-B output to approximately 10,000 μv. Adjust Band II OSC trimmer C142, then 2nd RF trimmer C131, then 1st RF trimmer C126, and finally ANT trimmer C120 for maximum deflection of tuning meter.
13	Set 65-B output to approximately 20 μv. Repeat adjustment of C142, C131, C126, and C120 for maximum deflection of tuning meter.
14	*With BTK-21C:* Set 65-B to exactly 1650 kc. Set MC BAND switch to Band III (.84–1.75). Rotate tuning knob 4.08 revolutions clockwise from minimum capacitance setting to set receiver to 1650 kc. *Without BTK-21C:* Set 65-B to exactly 1650 kc. Set control unit MC BAND switch to Band III (.84–1.75). Tune receiver to 1650 kc.
15	Set 65-B output to approximately 10,000 μv. Adjust Band III OSC trimmer C143, then 2nd RF trimmer C132, then 1st RF trimmer C127, and finally ANT trimmer C121 for maximum tuning meter deflection.
16	Set 65-B output to approximately 20 μv. Repeat adjustment of C143, C132, C127, and C121 for maximum deflection of tuning meter.

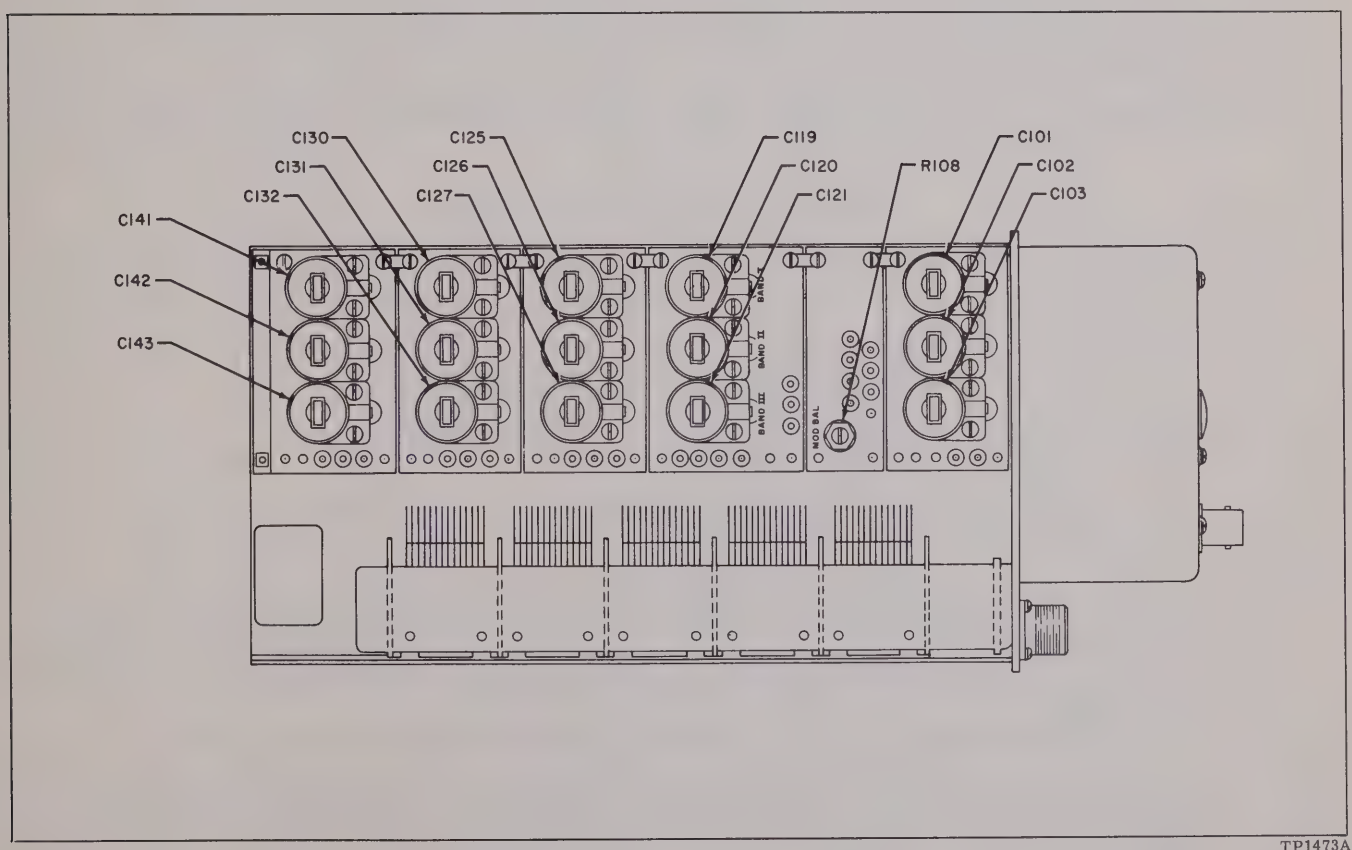


Figure 5–6. R-30B Receiver, Alignment Points

TABLE 5–5. RECEIVER ALIGNMENT — Continued

Step	Procedure
	LOOP AMPLIFIER ALIGNMENT
17	Set function switch to LOOP and MC BAND switch to Band I (.19–.40).
18	*With BTK-21C:* Set antenna position simulator FUNCTION switch to LOOP COMP. Set LOOP MOTOR switch ON. Press LOOP switch to rotate goniometer-indicator pointer to either 90° or 270°, as read on goniometer-indicator with dial 0° position aligned with index. Release LOOP switch and set LOOP MOTOR switch OFF. *Without BTK-21C:* Set screen room function switch to COMP. Set control unit function switch to LOOP. Press LOOP switch to rotate goniometer-indicator pointer to a null position. Release LOOP switch.
19	Set 65-B to exactly 380 kc.
20	*With BTK-21C:* Rotate tuning knob 3.58 revolutions clockwise from minimum capacitance setting to set receiver to 380 kc. *Without BTK-21C:* Tune receiver to 380 kc.
21	Set VOL control to extreme clockwise position (disregard audio distortion).
22	Increase 65-B output until tuning meter is deflected approximately one division.
23	Adjust Band I loop circuit trimmer C101 for maximum deflection of tuning meter.
24	Set 65-B to exactly 800 kc. Set MC BAND switch to Band II (.40–.84). *Do not change tuning of receiver.* Increase 65-B output until tuning meter is deflected approximately one division. Adjust Band II loop circuit trimmer C102 for maximum deflection of tuning meter.
25	*With BTK-21C:* Set 65-B to exactly 1650 kc. Set MC BAND switch to Band III (.84–1.75). Rotate tuning knob 4.08 revolutions clockwise from minimum capacitance setting to set receiver to 1650 kc. *Without BTK-21C:* Set 65-B to exactly 1650 kc. Set control unit MC BAND switch to Band III (.84–1.75). Tune receiver to 1650 kc.
26	Increase 65-B output until tuning meter is deflected approximately one division. Adjust Band III loop circuit trimmer C103 for maximum deflection of tuning meter.
	BALANCED MODULATOR ADJUSTMENT
27	*With BTK-21C:* Set MC BAND switch to Band I (.19–.40). Rotate tuning knob 3.58 revolutions clockwise from minimum capacitance setting to set receiver to 380 kc. Make certain no signal is being received; detune if necessary. *Without BTK-21C:* Set control unit MC BAND switch to Band I (.19–.40). Tune receiver to 380 kc. Make certain no signal is being received; detune slightly if necessary.
28	*With BTK-21C:* Set function switch to COMP and LOOP MOTOR switch ON. *Without BTK-21C:* Set control unit function switch to COMP.
29	With no output from 65-B, adjust MOD BAL potentiometer R108 for minimum rotational speed of goniometer-indicator pointer.
30	*With BTK-21C:* Set MC BAND switch to Band II (.40–.84) (do not change tuning of receiver) and note speed of goniometer-indicator pointer rotation. Then set MC BAND switch to Band III (.84–1.75), rotate tuning knob 4.08 revolutions clockwise from minimum capacitance setting, and note speed of goniometer-indicator pointer rotation. Make certain no signal is being received in either band position; detune slightly if necessary. *Without BTK-21C:* Same as with BTK-21C, except in Band III position tune receiver to 1650 kc.
31	Reset MOD BAL potentiometer R108 for optimum compromise (minimum rotation) on all bands. Under no-signal conditions, goniometer-indicator pointer should not rotate faster than 180° in 30 seconds in any band.

Goniometer-Indicator. If the goniometer-indicator has been disassembled, the following alignment procedure must be performed. Alignment and adjustment points of the goniometer-indicator are shown in Figure 5–7. A bench test interconnection diagram for alignment of the goniometer-indicator is shown in Figure 5–8.

Step 1. Set all compensation adjustment screws to their maximum counterclockwise positions (minimum compensation). Using VAR. control, set 0° on dial under index. Using goniometer drive gear, set cam follower over 45° compensation adjustment screw and goniometer dial to 45°. Note pointer reading.

Step 2. Set 45° compensation adjustment screw to its maximum clockwise position (maximum compensation). Note pointer reading. Compute total range of compensation by obtaining difference between pointer reading of this step and Step 1. Divide difference (at least 50°) by 2 and add resultant figure to pointer reading. This figure is midrange of the 45° compensation adjustment screw.

Step 3. Set 45° compensation adjustment screw to its midrange point.

Note

To prevent damage to the cam follower track, adjust adjacent compensation adjustment screws so that the cam follower track is sloped.

If necessary, realign cam follower over 45° compensation adjustment screw. Next align fiducial mark and 45° position on goniometer dial by loosening screws securing fiducial bracket in position, adjusting fiducial bracket, and then tightening screws.

Step 4. Interconnect goniometer-indicator and test equipment as shown in Figure 5–8.

Step 5. Set Measurements Model 65-B Signal Generator output for 100,000 cps, 2 volts. Set Hewlett-Packard Model 200AB Audio Oscillator output for 400 cps, 26 volts. Adjust Tektronix Model 310 Oscilloscope for suitable presentation.

Step 6. Rotate goniometer drive gear until horizontal line is observed on 310. This position is a null position, of which there are two. To determine correct null position, rotate goniometer dial and observe horizontal line of 310; it should rotate in same direction as goniometer dial.

Step 7. Adjust goniometer dial in vicinity of correct null for minimum voltage as read on Boonton Electronics Model 91C R-f Voltmeter.

Note

Do not allow gear train or goniometer to rotate.

Step 8. Loosen setscrews securing center spring gear and align 45° mark on goniometer dial with fiducial mark. Tighten setscrews.

Step 9. Loosen setscrews securing pointer adjustment gear and align pointer with 45° index. Tighten setscrews.

Step 10. Repeat Steps 6 through 9 until maximum accuracy of alignment is obtained.

Step 11. Rotate goniometer drive gear until 75° mark on goniometer dial is aligned with fiducial. Adjust 75° compensation adjustment screw until pointer indicates 75°. Repeat this step at each compensation point in a numerically increasing sequence.

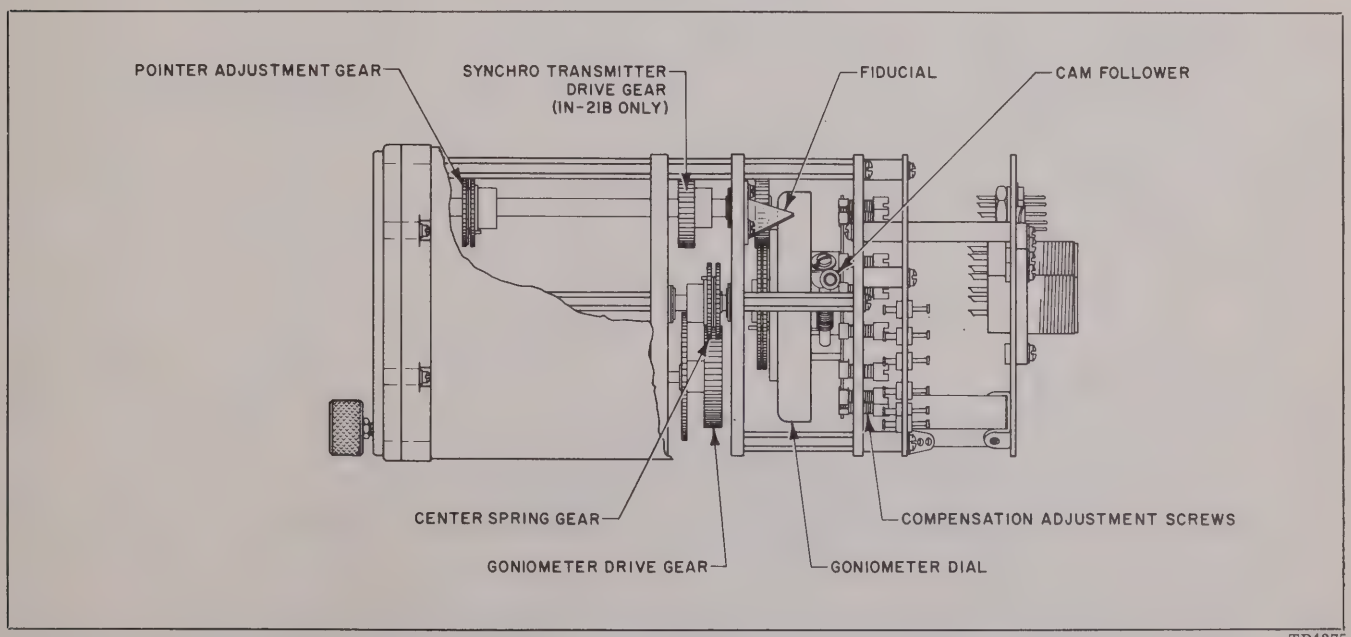
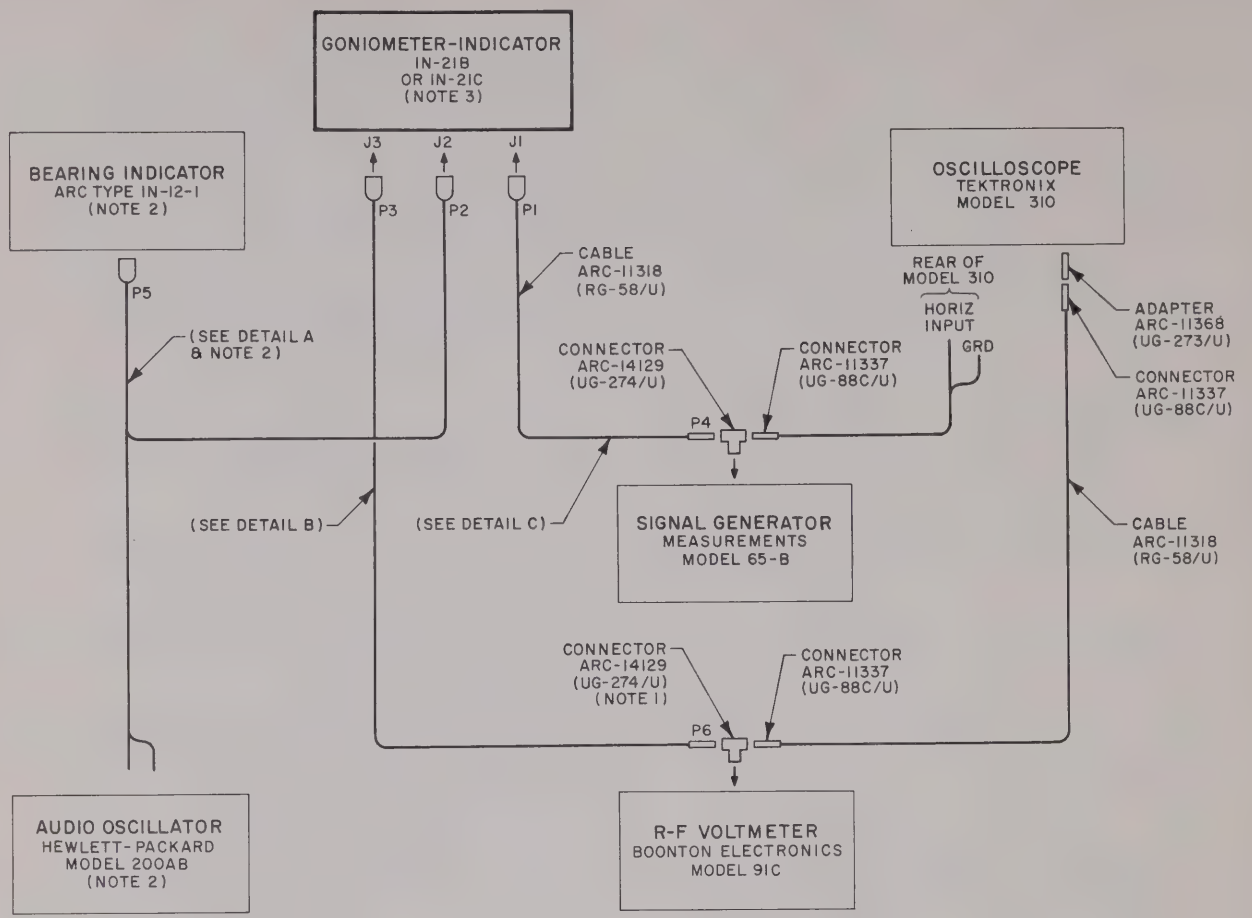
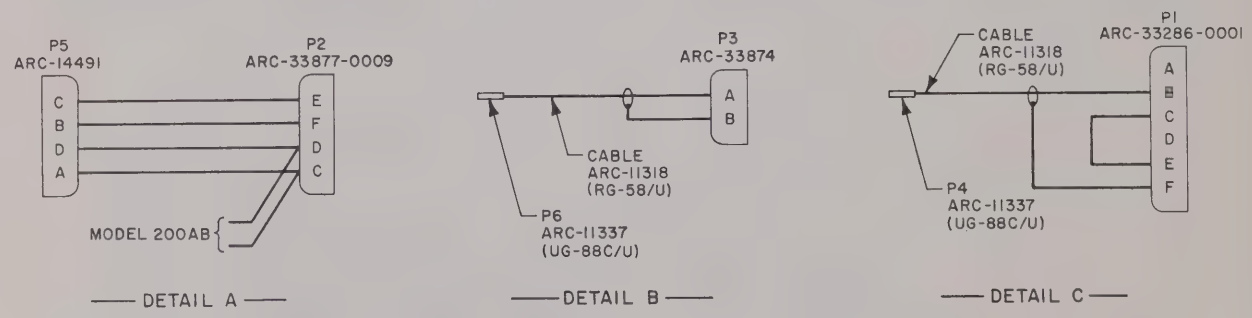


Figure 5–7. Goniometer-Indicator, Alignment Points





EQUIVALENT TEST EQUIPMENT MAY BE SUBSTITUTED FOR THAT SHOWN

NOTES:

1. USE BNC ADAPTER SUPPLIED WITH MODEL 91C.
2. USED ONLY FOR ALIGNMENT OF IN-21B GONIOMETER-INDICATOR.
3. GONIOMETER-INDICATOR MUST BE WIRED FOR TOP SENSE ANTENNA AND BOTTOM LOOP ANTENNA LOCATIONS.

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Figure 5–8. Bench Test Interconnection Diagram for Goniometer-Indicator Alignment

CAUTION

Do not force compensation adjustment screws. If correct pointer reading cannot be obtained, go on to next compensation adjustment screw, adjust, and then return.

Step 12. If aligning IN-21B Goniometer-Indicator, loosen setscrews securing synchro transmitter drive gear and adjust synchro transmitter spring gear until IN-12-1 Bearing Indicator pointer reading is the same as goniometer-indicator pointer reading.

5–8. MEASUREMENTS.

Typical voltage and resistance measurements for the receiver are given in Figure 5–9. Receiver r-f and i-f stage gain measurements are listed in Table 5–6, and receiver servo amplifier stage gain measurements are listed in Table 5–7. Table 5–8 lists the Dynaverter operating voltages. Goniometer-indicator resistance measurements are listed in Table 5–9. All measurements were made under the conditions noted.

TABLE 5–6. RECEIVER R-F AND I-F STAGE GAIN MEASUREMENTS

Conditions:

1. Avc line shorted to ground (terminal 3 of Z105 shorted to chassis).
2. Function switch in ANT or LOOP position, as noted.
3. VOL control set at maximum (extreme clockwise rotation).
4. The input shown is the signal level required to obtain —15 volts dc between the junction of resistors R130 and R131 (at the detector load) and the chassis. The voltage must be read by a d-c vacuum tube voltmeter.
5. The voltage levels are average values. Variations of 100 per cent or more from these values may be encountered in normal receivers because of variations in the tubes of the cascaded stages of the receiver. The greatest variations will be encountered in the r-f stages because of the effects of receiver noise and the fact that all amplifiers are in use.
6. Signal is applied to measurement points directly from the ungrounded side of the signal generator, except as noted. The signal generator ground terminal is connected directly to the receiver chassis.
7. The i-f measurements are made with receiver tuned to 190 kc. Signal generator frequency is 142.5 kc.

R-F MEASUREMENTS

(μv for —15 volts dc detector voltage)

Function Selector Switch		LOOP Position			ANT Position		
Frequency (kc)	Band (mc)	μv/Meter at L-40B Loop[1]	μv at Terminal 1 of V101	μv at Terminal 5 of V102[2]	μv at J102 Antenna Input	μv at Terminal 1 of V103[3]	μv at Terminal 1 of V105
210	.19–.40	80	5	20	10	45	25
380	.19–.40	30	5	10	8	20	25
450	.40–.84	70	6	11	14	45	25
800	.40–.84	30	6	6	10	32	25
950	.84–1.75	70	8	7	8	20	25
1650	.84–1.75	55	10	5	8	20	25

I-F MEASUREMENTS

Frequency	μv at Terminal 1 of V105	μv at Terminal 1 of V106	μv at Terminal 1 of V107
142.5 kc	20	2000	500,000

[1]Signal strength in μv/ meter required at the loop antenna is provided by the Antenna Position Simulator of the ARC Type BTK-21C Bench Test Kit or by a calibrated screen room. (Refer to Test Equipment in paragraph 5–2.)
[2]Apply signal to terminal 5 of V101 through a .01-μf capacitor.
[3]Signal is applied to J102 through a 50-pf capacitor into the standard 100-pf sense antenna cable.

TABLE 5–7. RECEIVER SERVO AMPLIFIER STAGE GAIN MEASUREMENTS

Conditions:

1. Detector output shorted to ground (terminal 3 of Z109 shorted to chassis).
2. Audio input voltage read on Ballantine Model 300D voltmeter, or equivalent.
3. Audio output voltage read on Ballantine Model 300D voltmeter, or equivalent, across 100-cycle output transformer T704 in Dynaverter (terminal 4 of T704 to chassis). If a BTK-21C is used, the audio output may be measured between the GND and $\phi 2$ jacks on the ADF Test Panel.
4. The goniometer-indicator is connected as the amplifier load in the normal manner for these measurements.
5. Function switch in COMP position.
6. Voltage inputs are shown for both 100 and 200 cycles. The amplifier operates at 100 cycles and therefore 100-cycle readings of stage gain show behavior of the amplifier at the normal operating frequency. The 200-cycle inputs serve as an indication of phase and frequency response.
7. Voltage inputs are referred to chassis ground potential to produce 20 volts output.

SERVO AMPLIFIER MEASUREMENTS
(Voltage inputs to produce 20 volts output)

Test Point	*Volts at 100 Cycles*	*Volts at 200 Cycles*
Voltage at junction of R130 and R131	0.25	Approximately 4 times 100-cycle input
Voltage at pin 1 of V111	0.055	Approximately 3 times 100-cycle input
Voltage at pin 2 of V112	0.2	Approximately 1.6 times 100-cycle input
Voltage at pin 7 of V112	0.4	Approximately 1.6 times 100-cycle input
Voltage at pin 1 of V113	4.5	Approximately 1.5 times 100-cycle input
Voltage at pin 1 of V114	6.5	Approximately 1.5 times 100-cycle input

SERVO AMPLIFIER OUTPUT LEVEL[1]

Frequency	*Input to Junction of R130 and R131*	*Output of T301 in Dynaverter*
100 cycles	2.0 volts	At least 35.0 volts

[1]Measured with goniometer-indicator connected in normal manner as amplifier load and low-voltage input set to 13.75 or 27.5 volts dc, depending on voltage rating of equipment.

TABLE 5–8. DYNAVERTER VOLTAGE MEASUREMENTS

Conditions:

1. Voltage measurements made with a 20,000 ohms-per-volt voltmeter such as Simpson Model 260 Multimeter, or equivalent. All voltages are measured with respect to chassis ground; d-c voltages are positive.
2. Voltages shown in parentheses are for 14-volt model.
3. Measurements made with Dynaverter connected as shown in Figure 5–10 or 5–11.

Note

After dust cover is removed, transistors Q703, Q704, Q705, and Q706 are connected to their corresponding sockets by Test Harness 27579.

Ref Desig	*Test Point*	*D-c Volts*	*A-c Volts*[1]
CR703	Anode	1.0 approx.	—
	Cathode	0	—
J701	Pin B	27.5 (13.75)	—
	Pin E	—	13.5 (13.5)
	Pin H	—	13.25 (13.3)
	Pin I	27.5 (13.75)	—
	Pin J (HV1)	122 (130)	—
	Pin K (HV2)	115 (125)	—
L701	Input	27.5 (13.75)	—
	Output	27.5 (13.75)	—
Q701	Emitter	25.0 (12.75)	0.35 (0.4)
	Base	26.75 (13.0)	0.5 (0.4)
	Collector	—	9.0 (4.1)
Q702	Emitter	25.0 (12.75)	0.35 (0.4)
	Base	26.75 (13.0)	0.5 (0.4)
	Collector	—	9.0 (4.1)
Q703	Emitter	27.5 (13.5)	29.0 (14.0)
	Base	30.2 (14.75)	33.0 (16.0)
	Collector	0	0
Q704	Emitter	27.5 (13.5)	29.0 (14.0)
	Base	30.2 (14.75)	33.0 (16.0)
	Collector	0	0
Q705	Emitter	26.5 (13.0)	16.5 (8.0)
	Base	27.5 (14.0)	17.0 (9.0)
	Collector	0	0
Q706	Emitter	26.5 (13.0)	16.5 (8.0)
	Base	27.5 (14.0)	17.0 (9.0)
	Collector	0	0

[1]Measure all a-c voltages (except those on pins E and H) using a 0.1-μf blocking capacitor; if a Simpson Model 260 is used, no external blocking capacitor is required, provided the meter function switch is set to OUTPUT.

TABLE 5–9. GONIOMETER-INDICATOR RESISTANCE MEASUREMENTS

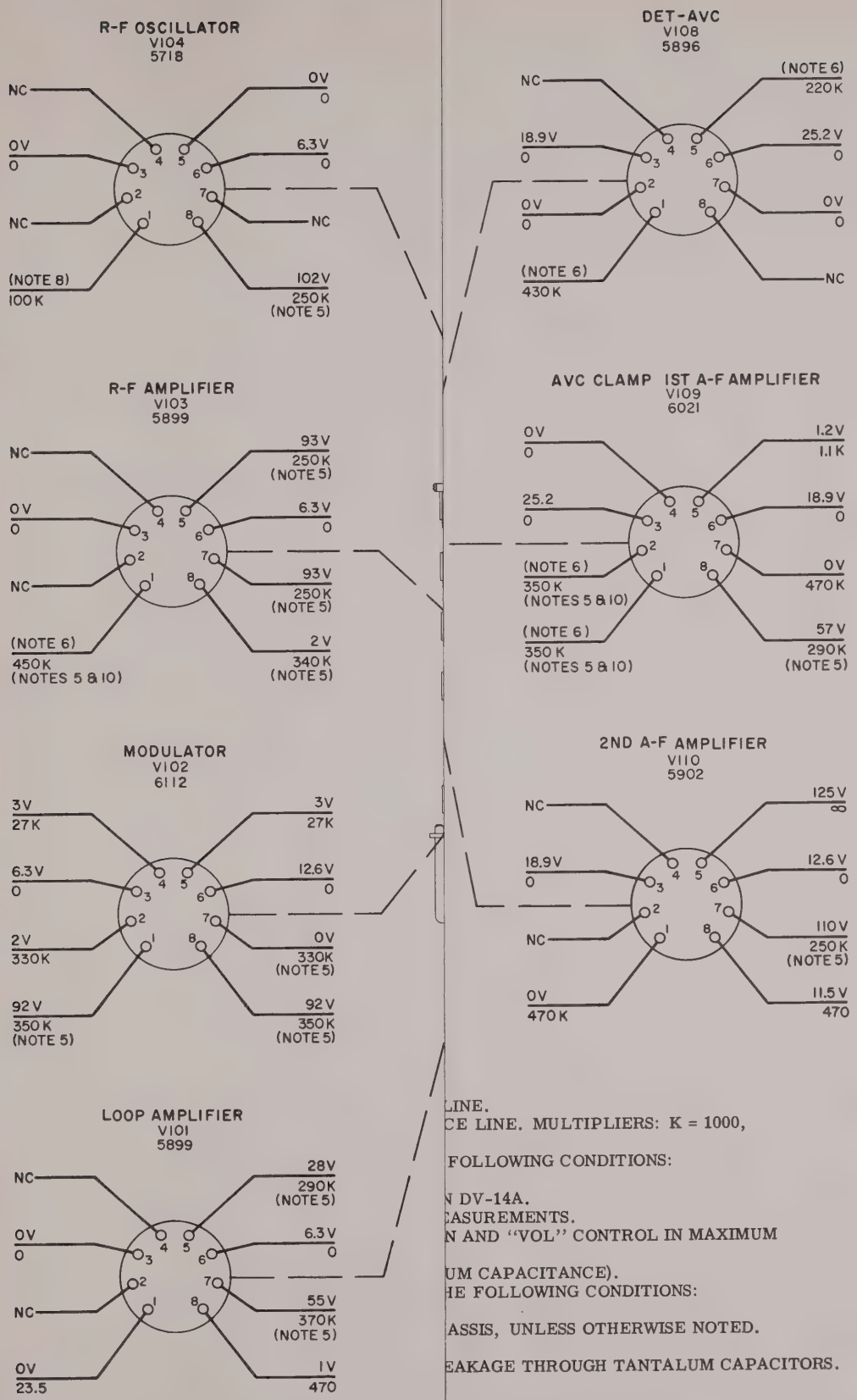
Note

Pin-to-pin or pin-to-ground measurements not included in this table are infinite.

Conditions:

1. All cables disconnected.
2. Measurements made with Hewlett-Packard Model 410B vtvm.
3. Values are approximate (tolerance ±10%).
4. Values apply to both IN-21B and IN-21C, except, where two values are stated, value in parentheses applies to IN-21B, the other to IN-21C.

From		To		Resistance (ohms)
Connector	Pin	Connector	Pin	
J1	A	J1	D	0
		J3	C	0
	B	J1	E	1
	C	J1	F	1
	D	J3	C	0
J2	A	J2	B	450
			C	35
			D	(65)
			E	(45)
			F	(45)
			K	35
		GRD		35
	B	J2	C	410
			D	(450)
			E	(420)
			F	(420)
			K	410
		GRD		410
	C	J2	D	(35)
			E	(10)
			F	(10)
			K	0
		GRD		0
	D	J2	E	(40)
			F	(40)
			K	(30)
		GRD		(30)
	E	J2	F	(20)
			K	(10)
		GRD		(10)
	F	J2	K	(10)
		GRD		(10)
	K	GRD		0
J3	A	J3	B	1
			C	0
	B		C	0
	C	GRD		0



LINE.
CE LINE. MULTIPLIERS: K = 1000,

FOLLOWING CONDITIONS:

N DV-14A.
CASUREMENTS.
N AND "VOL" CONTROL IN MAXIMUM

UM CAPACITANCE).
HE FOLLOWING CONDITIONS:

ASSIS, UNLESS OTHERWISE NOTED.

EAKAGE THROUGH TANTALUM CAPACITORS.

TUNING CAPACITOR POSITION. VOLTAGE

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Figure 5–9. R-30B Receiver, Voltage and Resistance Measurements

TABLE 5–9. GONIOMETER-INDICATOR RESISTANCE MEASUREMENTS

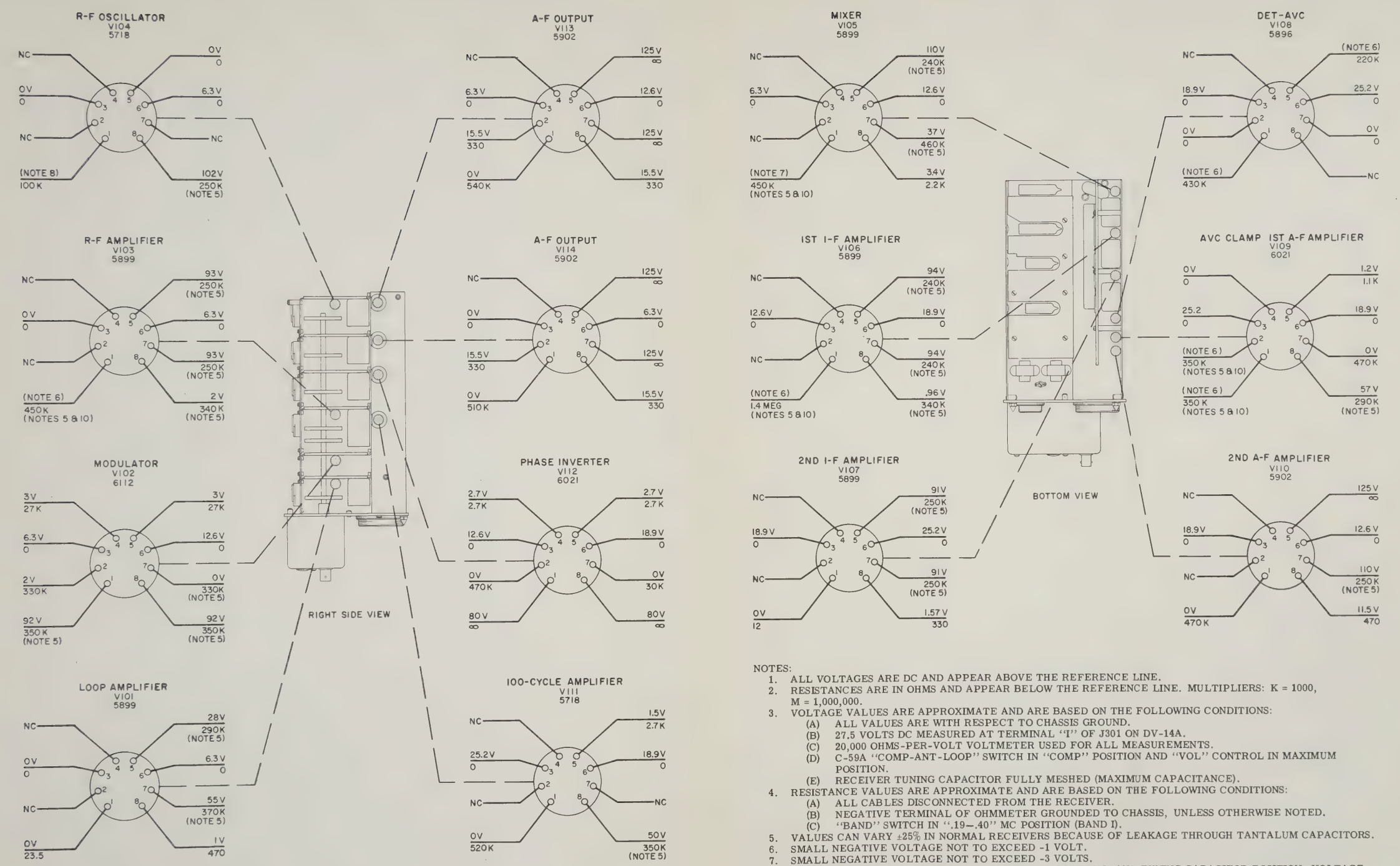
Note

Pin-to-pin or pin-to-ground measurements not included in this table are infinite.

Conditions:

1. All cables disconnected.
2. Measurements made with Hewlett-Packard Model 410B vtvm.
3. Values are approximate (tolerance ±10%).
4. Values apply to both IN-21B and IN-21C, except, where two values are stated, value in parentheses applies to IN-21B, the other to IN-21C.

From		To		Resistance (ohms)
Connector	Pin	Connector	Pin	
J1	A	J1	D	0
		J3	C	0
	B	J1	E	1
	C	J1	F	1
	D	J3	C	0
J2	A	J2	B	450
			C	35
			D	(65)
			E	(45)
			F	(45)
			K	35
		GRD		35
	B	J2	C	410
			D	(450)
			E	(420)
			F	(420)
			K	410
		GRD		410
	C	J2	D	(35)
			E	(10)
			F	(10)
			K	0
		GRD		0
	D	J2	E	(40)
			F	(40)
			K	(30)
		GRD		(30)
	E	J2	F	(20)
			K	(10)
		GRD		(10)
	F	J2	K	(10)
		GRD		(10)
	K	GRD		0
J3	A	J3	B	1
			C	0
	B		C	0
	C	GRD		0



NOTES:

1. ALL VOLTAGES ARE DC AND APPEAR ABOVE THE REFERENCE LINE.
2. RESISTANCES ARE IN OHMS AND APPEAR BELOW THE REFERENCE LINE. MULTIPLIERS: K = 1000, M = 1,000,000.
3. VOLTAGE VALUES ARE APPROXIMATE AND ARE BASED ON THE FOLLOWING CONDITIONS:
   (A) ALL VALUES ARE WITH RESPECT TO CHASSIS GROUND.
   (B) 27.5 VOLTS DC MEASURED AT TERMINAL "I" OF J301 ON DV-14A.
   (C) 20,000 OHMS-PER-VOLT VOLTMETER USED FOR ALL MEASUREMENTS.
   (D) C-59A "COMP-ANT-LOOP" SWITCH IN "COMP" POSITION AND "VOL" CONTROL IN MAXIMUM POSITION.
   (E) RECEIVER TUNING CAPACITOR FULLY MESHED (MAXIMUM CAPACITANCE).
4. RESISTANCE VALUES ARE APPROXIMATE AND ARE BASED ON THE FOLLOWING CONDITIONS:
   (A) ALL CABLES DISCONNECTED FROM THE RECEIVER.
   (B) NEGATIVE TERMINAL OF OHMMETER GROUNDED TO CHASSIS, UNLESS OTHERWISE NOTED.
   (C) "BAND" SWITCH IN ".19—.40" MC POSITION (BAND I).
5. VALUES CAN VARY ±25% IN NORMAL RECEIVERS BECAUSE OF LEAKAGE THROUGH TANTALUM CAPACITORS.
6. SMALL NEGATIVE VOLTAGE NOT TO EXCEED -1 VOLT.
7. SMALL NEGATIVE VOLTAGE NOT TO EXCEED -3 VOLTS.
8. VOLTAGE DEPENDENT ON METER LEADS, BAND POSITION, AND TUNING CAPACITOR POSITION. VOLTAGE NOT TO EXCEED -7 VOLTS.
9. NC INDICATES NO CONNECTION.
10. POSITIVE PROBE OF OHMMETER AT GROUND POTENTIAL.

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Figure 5–9. R-30B Receiver, Voltage and Resistance Measurements

SECTION VI
DIAGRAMS

Figure 6–1. R-30B Receiver, Schematic Diagram

Figure 6–2. R-30B Receiver, Wiring Diagram

Figure 6–3. R-30B Receiver, Loop Amplifier Assembly Z101, Wiring Diagram

Figure 6–4. R-30B Receiver, Modulator Assembly Z102, Wiring Diagram

Figure 6–5. R-30B Receiver, Antenna Assembly Z103, Wiring Diagram

Figure 6–6. R-30B Receiver, First R-f Assembly Z104, Wiring Diagram

Figure 6–7. R-30B Receiver, Second R-f Assembly Z105, Wiring Diagram

Figure 6–8. R-30B Receiver, Oscillator Assembly Z106, Wiring Diagram

Figure 6–9. C-59A Control Unit, Schematic Diagram

Figure 6–10. C-59A Control Unit, Wiring Diagram

Figure 6–11. CC-14A Control Unit, Schematic Diagram

Figure 6–12. CC-14A Control Unit, Wiring Diagram

Figure 6–13. CC-15A Control Unit, Schematic Diagram

Figure 6–14. CC-15A Control Unit, Wiring Diagram

Figure 6–15. DV-14A Dynaverter, Schematic Diagram

Figure 6–16. DV-14A Dynaverter, Wiring Diagram

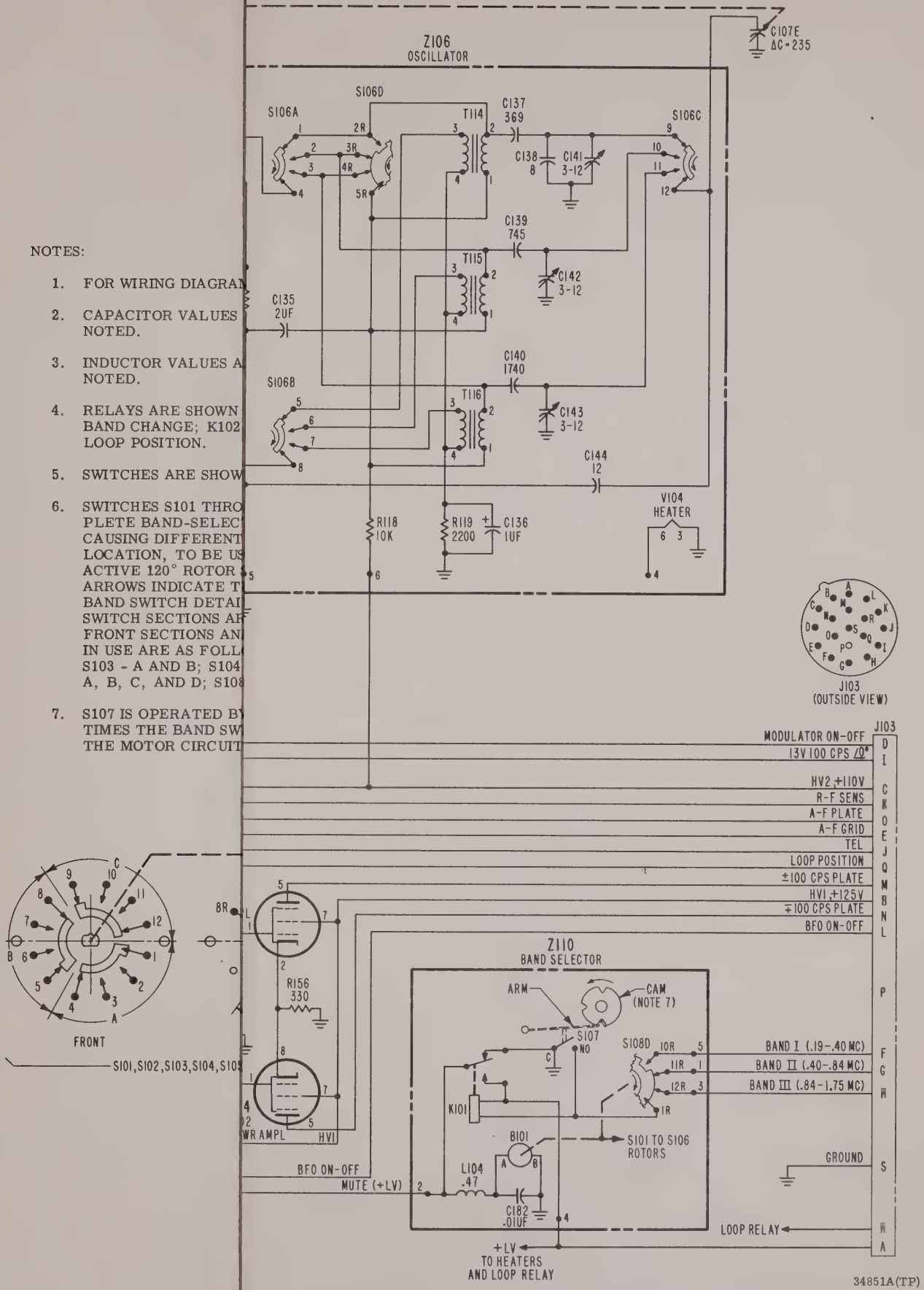
Figure 6–17. IN-21B Goniometer-Indicator, Schematic Diagram

Figure 6–18. IN-21C Goniometer-Indicator, Schematic Diagram

Figure 6–19. L-40B Loop Antenna, Schematic Diagram

Figure 6–20. Loop Antenna Cable Assembly 32803, Wiring Diagram

Figure 6–21. Receiver Cable Assembly 33785, Wiring Diagram



NOTES:

1. FOR WIRING DIAGRA
2. CAPACITOR VALUES NOTED.
3. INDUCTOR VALUES A NOTED.
4. RELAYS ARE SHOWN BAND CHANGE; K102 LOOP POSITION.
5. SWITCHES ARE SHOW
6. SWITCHES S101 THRO PLETE BAND-SELEC CAUSING DIFFERENT LOCATION, TO BE US ACTIVE 120° ROTOR ARROWS INDICATE T BAND SWITCH DETAI SWITCH SECTIONS AR FRONT SECTIONS AN IN USE ARE AS FOLL S103 - A AND B; S104 A, B, C, AND D; S10
7. S107 IS OPERATED B TIMES THE BAND SW THE MOTOR CIRCUIT

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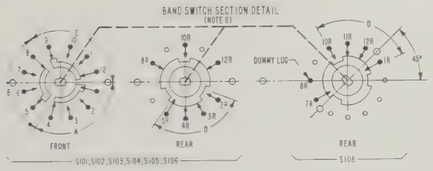
Figure 6–1. R-30B Receiver, Schematic Diagram

NOTES:

1. FOR WIRING DIAGRAM, SEE FIGURE 6-2.
2. CAPACITOR VALUES ARE IN PICOFARADS (PF), UNLESS OTHERWISE NOTED.
3. INDUCTOR VALUES ARE IN MICROHENRIES (μH), UNLESS OTHERWISE NOTED.
4. RELAYS ARE SHOWN UNENERGIZED. K101 IS ENERGIZED ONLY DURING BAND CHANGE; K102 IS ENERGIZED WHEN FUNCTION SWITCH IS IN LOOP POSITION.
5. SWITCHES ARE SHOWN IN BAND I (.19–.40) POSITION.
6. SWITCHES S101 THROUGH S106 AND S108 GO THROUGH THREE COMPLETE BAND-SELECTION CYCLES DURING ONE SHAFT REVOLUTION, CAUSING DIFFERENT SECTORS OF A ROTOR, AT ANY GIVEN CIRCUIT LOCATION, TO BE USED EACH CYCLE. FOR CLARITY, ONLY THE ACTIVE 120° ROTOR SECTOR FOR EACH SWITCH IS SHOWN. THE ARROWS INDICATE THE DIRECTION OF ROTATION. FOR ADDITIONAL BAND SWITCH DETAILS, SEE BAND SWITCH SECTION DETAILS. BAND SWITCH SECTIONS ARE IDENTIFIED BY LETTERS A, B, AND C FOR FRONT SECTIONS AND D FOR REAR SECTIONS. BAND SWITCH SECTIONS IN USE ARE AS FOLLOWS: S101 - A, B, C, AND D; S102 - A AND B; S103 - A AND B; S104 - A, B, AND D; S105 - A, B, C, AND D; S106 - A, B, C, AND D; S108 - D.
7. S107 IS OPERATED BY A MOTOR-DRIVEN CAM ROTATING AT THREE TIMES THE BAND SWITCH SPEED, AND ACTS AS A VERNIER TO OPEN THE MOTOR CIRCUIT AT PRECISE ANGLES.



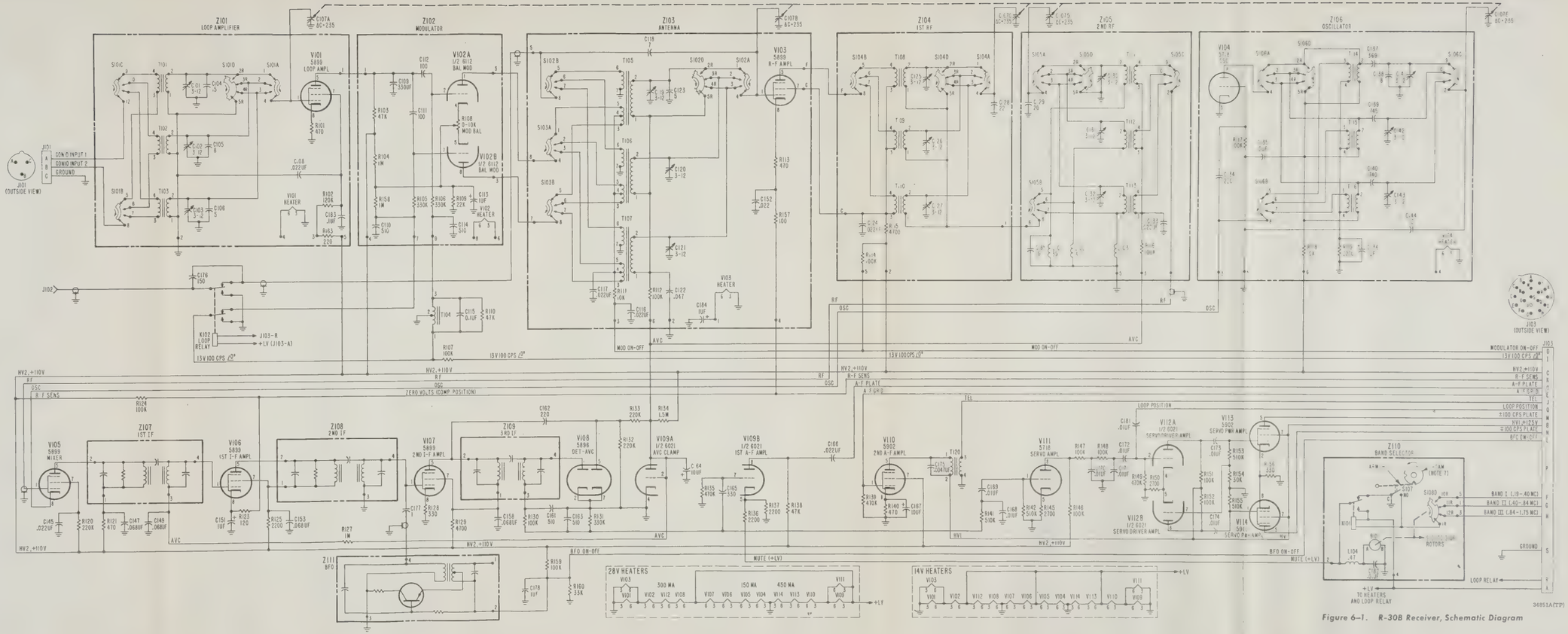
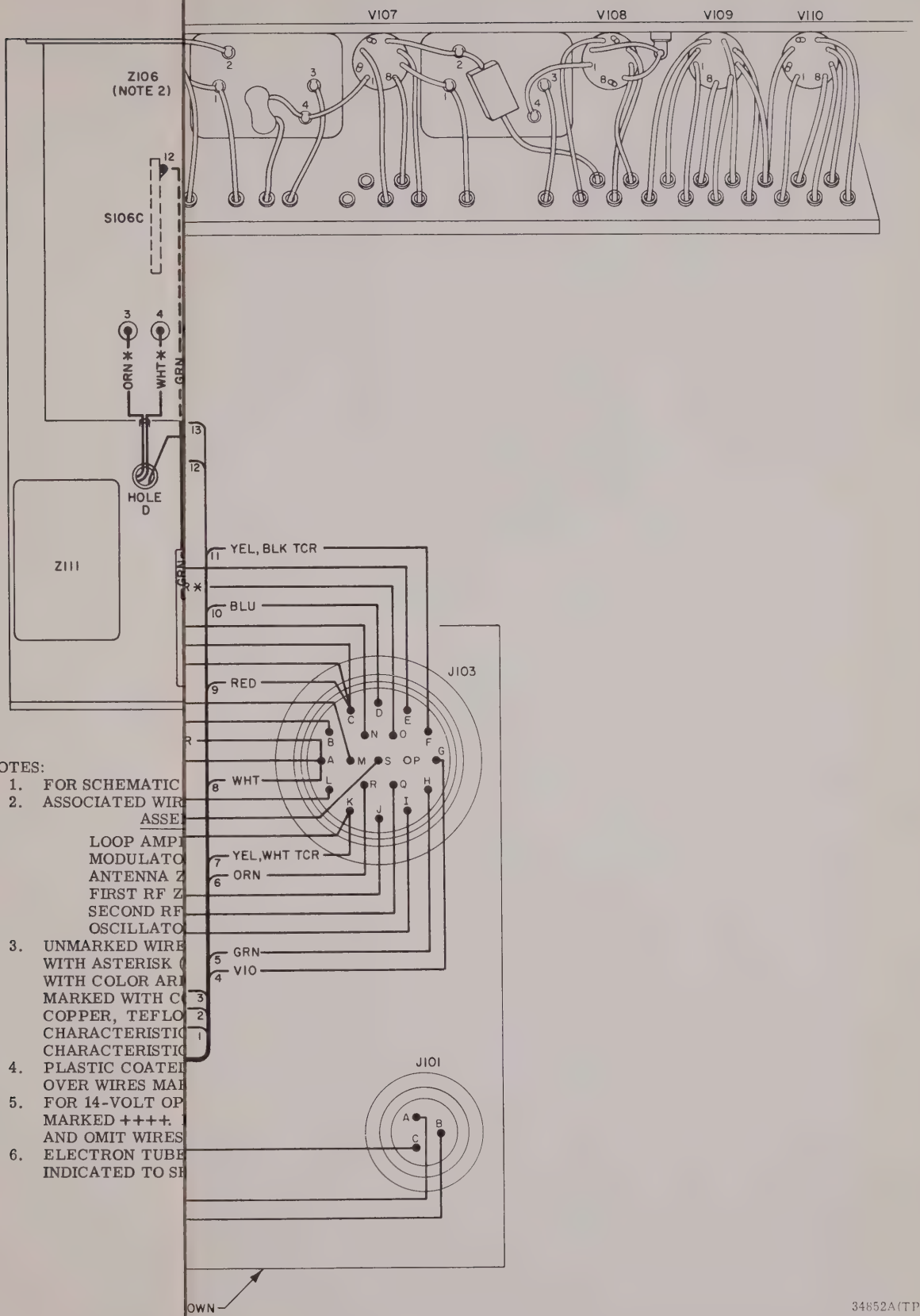


Figure 6-1. R-30B Receiver, Schematic Diagram



NOTES:

1. FOR SCHEMATIC
2. ASSOCIATED WIR
   ASSE
   LOOP AMPI
   MODULATO
   ANTENNA Z
   FIRST RF Z
   SECOND RF
   OSCILLATO
3. UNMARKED WIRE
   WITH ASTERISK (
   WITH COLOR ARI
   MARKED WITH C
   COPPER, TEFLO
   CHARACTERISTIC
   CHARACTERISTIC
4. PLASTIC COATE
   OVER WIRES MA
5. FOR 14-VOLT OP
   MARKED ++++.
   AND OMIT WIRES
6. ELECTRON TUBE
   INDICATED TO SE

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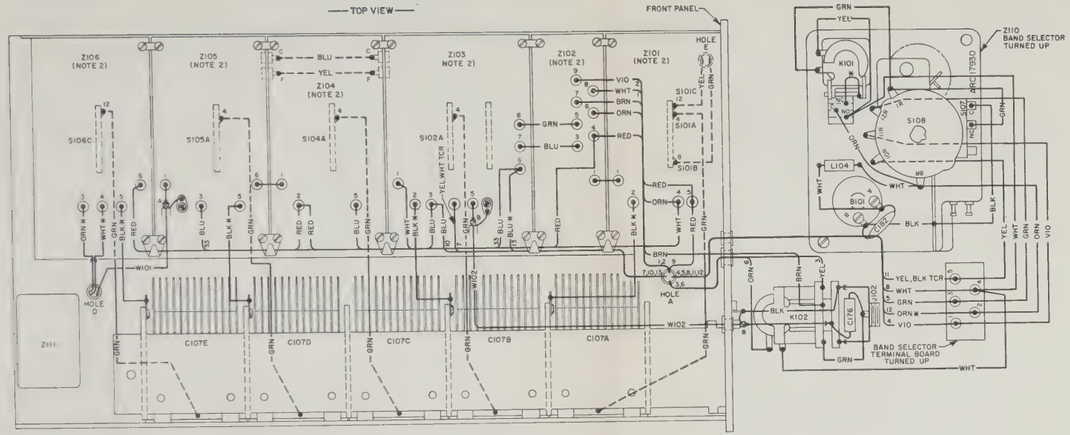
Figure 6–2. R-30B Receiver, Wiring Diagram

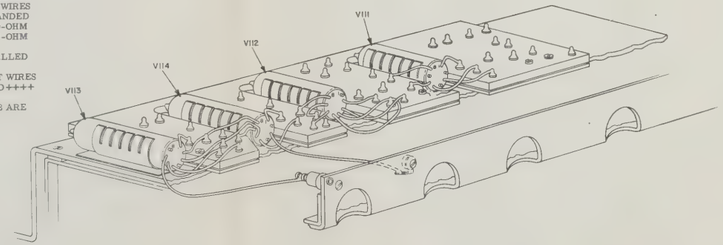


NOTES:

1. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
2. ASSOCIATED WIRING DIAGRAMS ARE AS FOLLOWS:

ASSEMBLY	FIGURE NO.
LOOP AMPLIFIER Z101	6-3
MODULATOR Z102	6-4
ANTENNA Z103	6-5
FIRST RF Z104	6-6
SECOND RF Z105	6-7
OSCILLATOR Z106	6-8

3. UNMARKED WIRES ARE NO. 24 AWG BARE, SOLID COPPER. WIRES MARKED WITH ASTERISK (*) ARE NO. 22 AWG BARE, SOLID COPPER. WIRES MARKED WITH COLOR ARE NO. 24 AWG SOLID COPPER, TEFLON INSULATED. WIRES MARKED WITH COLOR NOTE AND ASTERISK (*) ARE NO. 24 AWG STRANDED COPPER, TEFLON INSULATED. COAXIAL CABLE MARKED A HAS A 50-OHM CHARACTERISTIC IMPEDANCE. COAXIAL CABLE MARKED B HAS A 94-OHM CHARACTERISTIC IMPEDANCE.
4. PLASTIC COATED FIBERGLASS TUBING OF APPROPRIATE SIZE INSTALLED OVER WIRES MARKED -⊏- .
5. FOR 14-VOLT OPERATION, CONNECT WIRES MARKED •••• AND OMIT WIRES MARKED ++++. FOR 28-VOLT OPERATION, CONNECT WIRES MARKED++++ AND OMIT WIRES MARKED •••• .
6. ELECTRON TUBES ARE VIEWED TOWARD BASE. TUBE LEADS 1 AND 8 ARE INDICATED TO SHOW PROPER ORIENTATION OF TUBE.



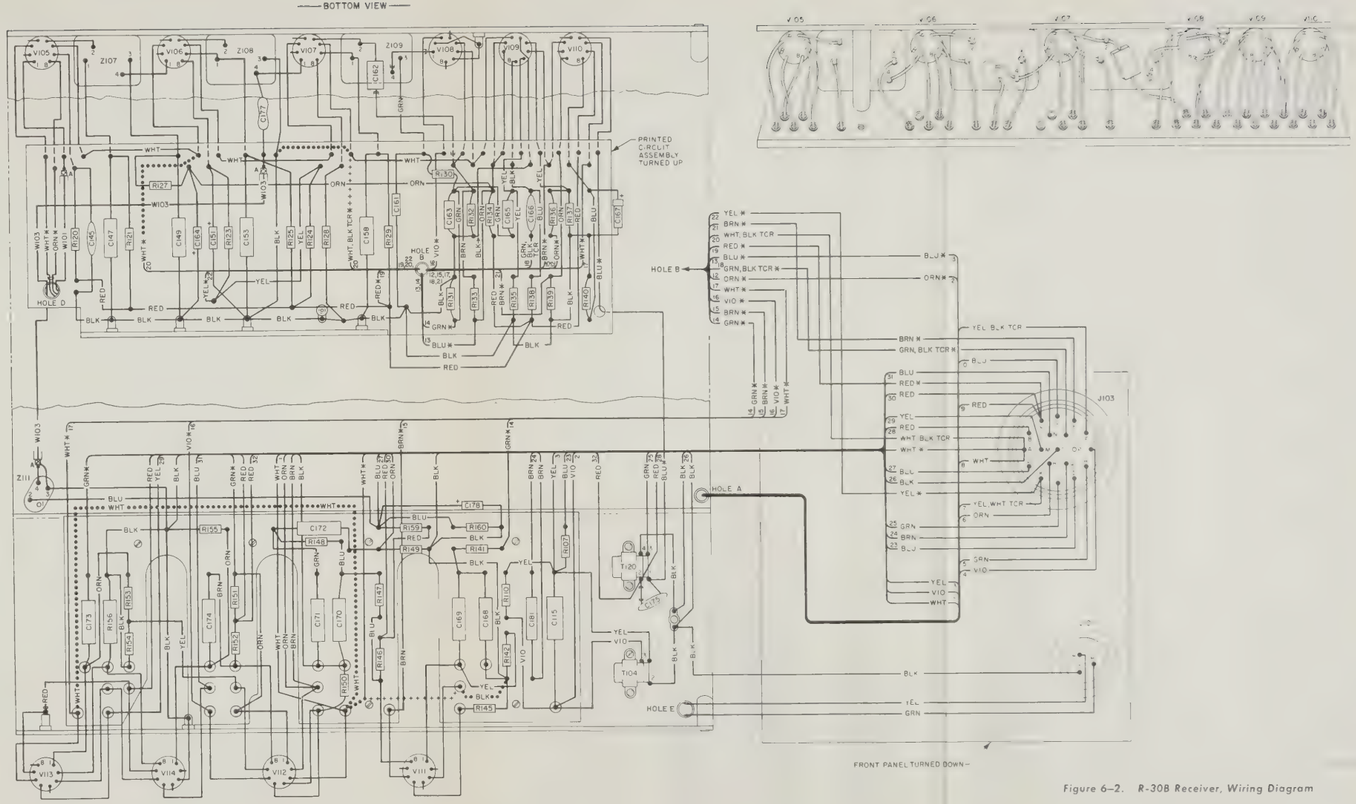
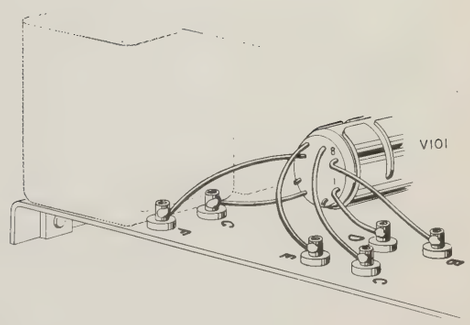


Figure 6–2. R-30B Receiver, Wiring Diagram

NOTES:

1. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
2. UNMARKED WIRES ARE NO. 24 AWG BARE, SOLID COPPER. WIRES MARKED WITH COLOR NOTE ARE NO. 24 AWG SOLID COPPER, TEFLON INSULATED.
3. ELECTRON TUBE IS VIEWED TOWARD BASE. TUBE LEADS 1 AND 8 ARE INDICATED TO SHOW PROPER ORIENTATION OF TUBE.
4. SWITCH SECTIONS:

SECTION	TERMINALS
S101A	1, 2, 3, 4
S101B	5, 6, 7, 8
S101C	9, 10, 11, 12
S101D	2R, 3R, 4R, 5R



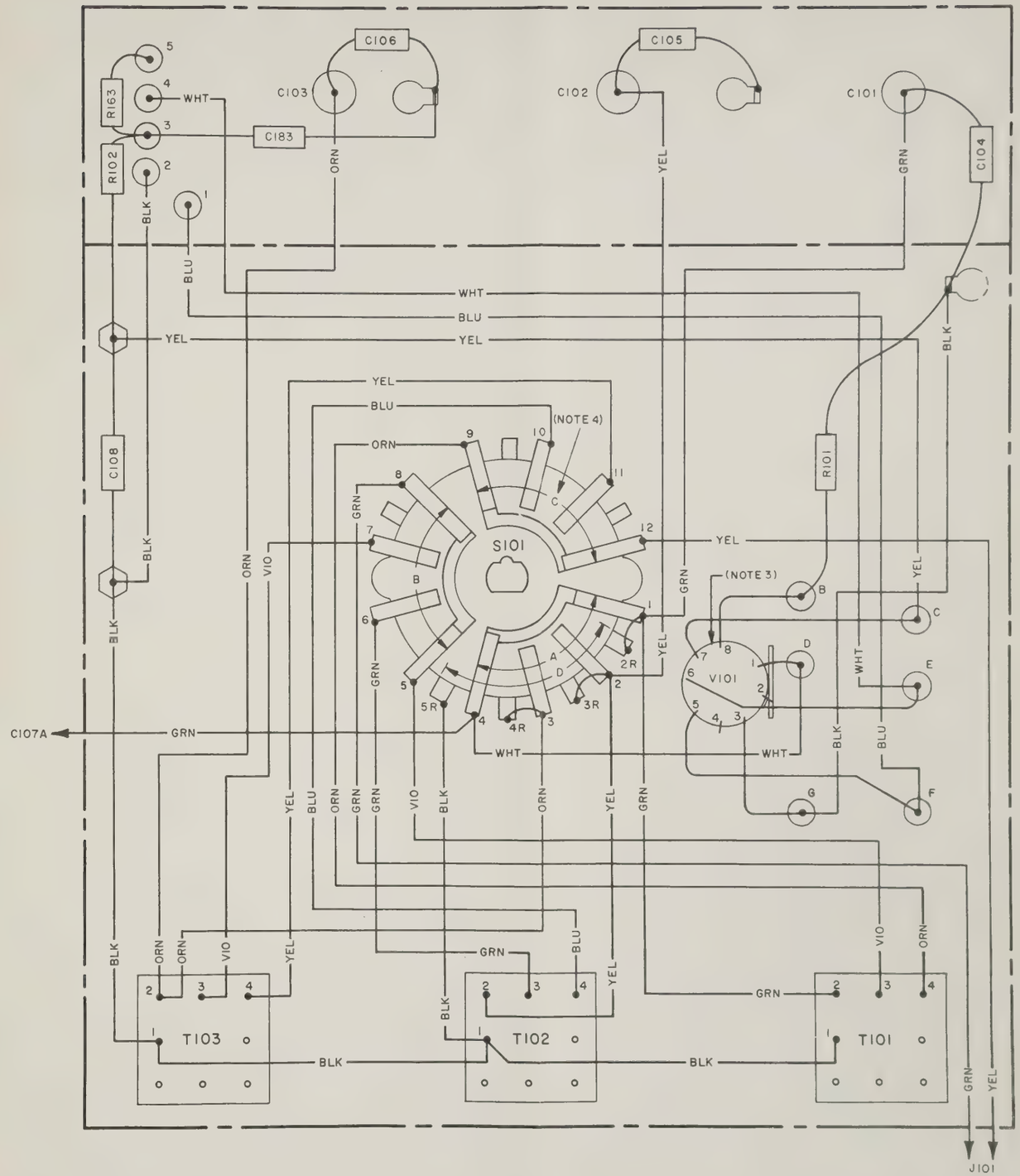


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Figure 6–3. R-308 Receiver, Loop Amplifier Assembly Z101, Wiring Diagram

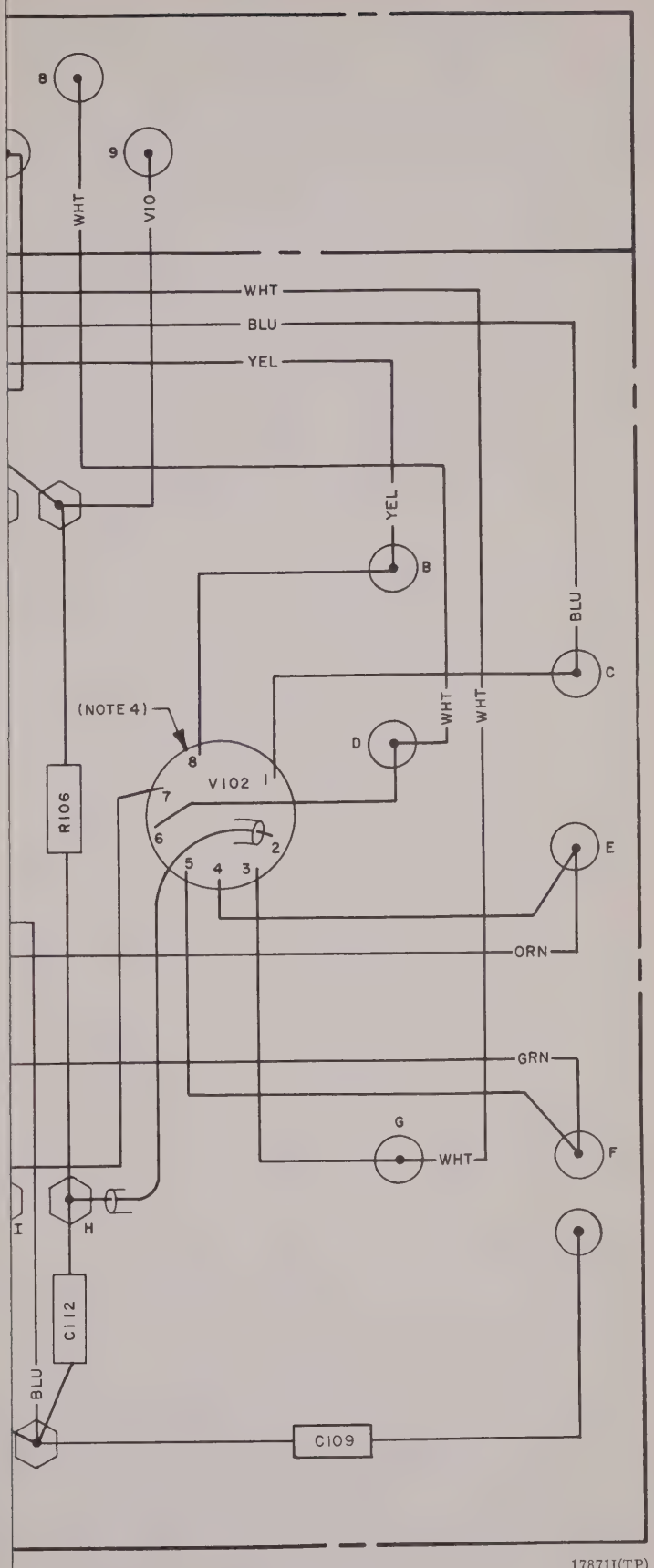

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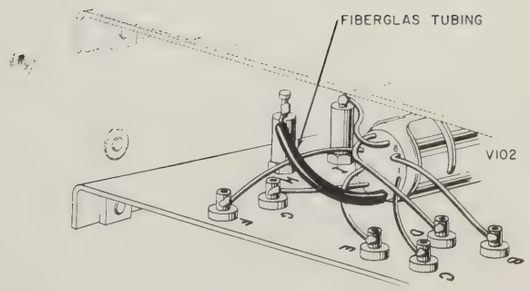
Figure 6–4. R-30B Receiver, Modulator Assembly Z102, Wiring Diagram

NOTES:

1. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
2. WIRES MARKED WITH COLOR NOTE ARE NO. 24 AWG SOLID COPPER, TEFLON INSULATED.
3. TEFLON IMPREGNATED FIBERGLASS TUBING OF APPROPRIATE SIZE INSTALLED OVER WIRES MARKED —⊏— .
4. ELECTRON TUBE IS VIEWED TOWARD BASE. TUBE LEADS 1 AND 8 ARE INDICATED TO SHOW PROPER ORIENTATION OF TUBE.



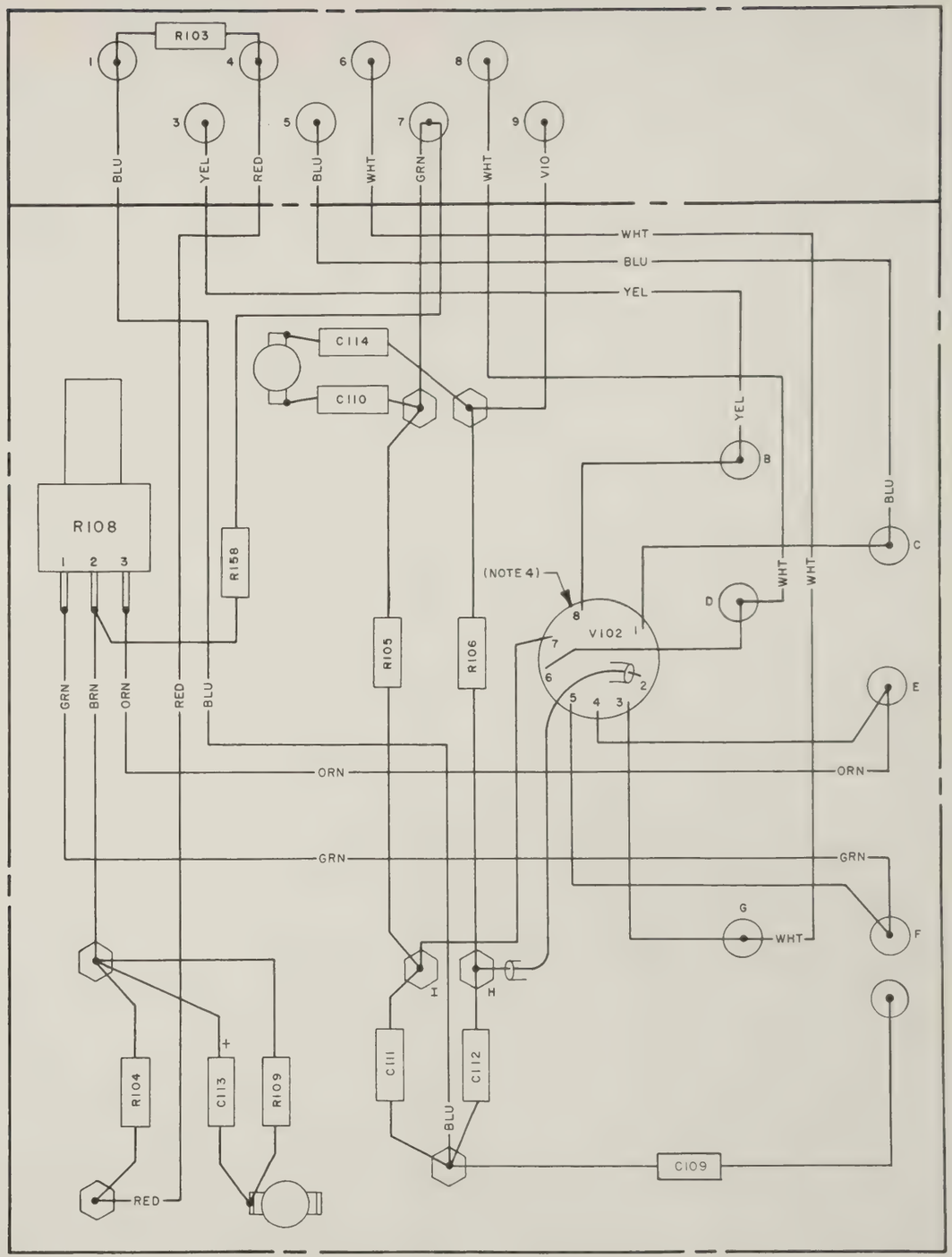


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Figure 6–4. R-30B Receiver, Modulator Assembly Z102, Wiring Diagram

NOTES:

1. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
2. UNMARKED WIRES ARE NO. 24 AWG BARE, SOLID COPPER. WIRES MARKED WITH COLOR NOTE ARE NO. 24 AWG SOLID COPPER, TEFLON INSULATED.
3. PLASTIC COATED FIBERGLASS TUBING OF APPROPRIATE SIZE INSTALLED OVER WIRES MARKED —⊂— .
4. ELECTRON TUBE IS VIEWED TOWARD BASE. TUBE TUBE LEADS 1 AND 8 ARE INDICATED TO SHOW PROPER ORIENTATION OF TUBE.
5. SWITCH SECTIONS:

SECTION	TERMINALS
S102A, S103A	1, 2, 3, 4
S102B, S103B	5, 6, 7, 8
S102C, S103C	9, 10, 11, 12
S102D, S103D	2R, 3R, 4R, 5R, 8R, 10R, 12R

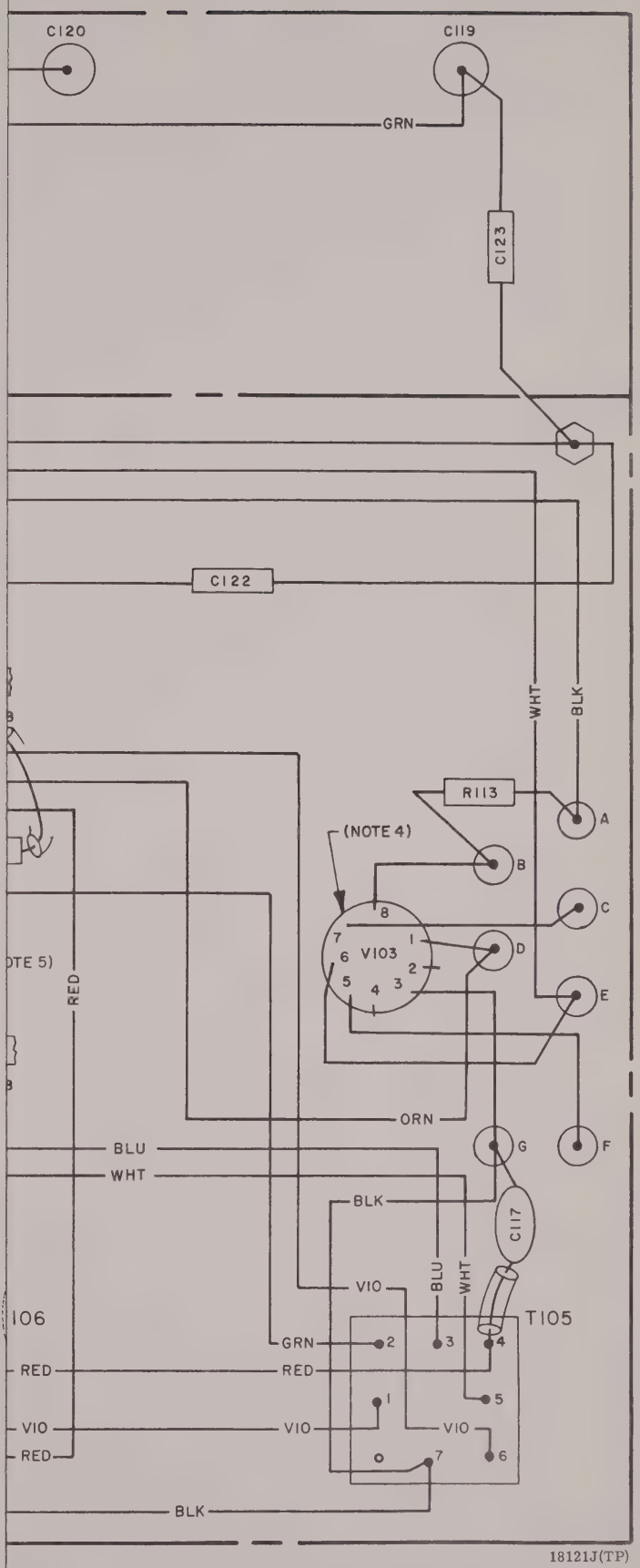
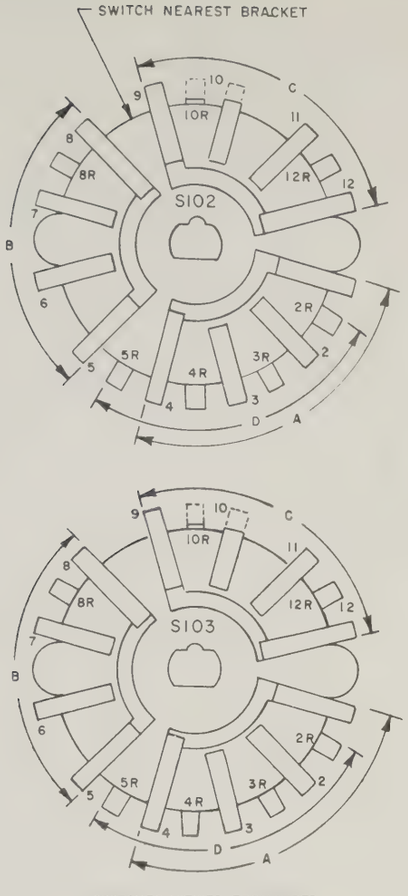


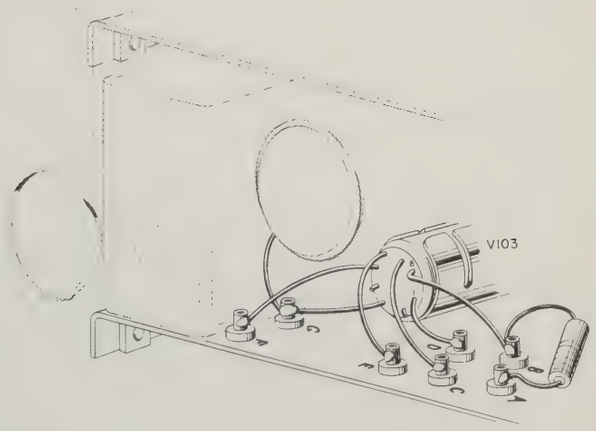
Figure 6–5. R-30B Receiver, Antenna Assembly Z103, Wiring Diagram

NOTES:

1. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
2. UNMARKED WIRES ARE NO. 24 AWG BARE, SOLID COPPER. WIRES MARKED WITH COLOR NOTE ARE NO. 24 AWG SOLID COPPER, TEFLON INSULATED.
3. PLASTIC COATED FIBERGLASS TUBING OF APPROPRIATE SIZE INSTALLED OVER WIRES MARKED ⊣⊏⊐⊢ .
4. ELECTRON TUBE IS VIEWED TOWARD BASE. TUBE TUBE LEADS 1 AND 8 ARE INDICATED TO SHOW PROPER ORIENTATION OF TUBE.
5. SWITCH SECTIONS:

SECTION	TERMINALS
S102A, S103A	1, 2, 3, 4
S102B, S103B	5, 6, 7, 8
S102C, S103C	9, 10, 11, 12
S102D, S103D	2R, 3R, 4R, 5R, 8R, 10R, 12R





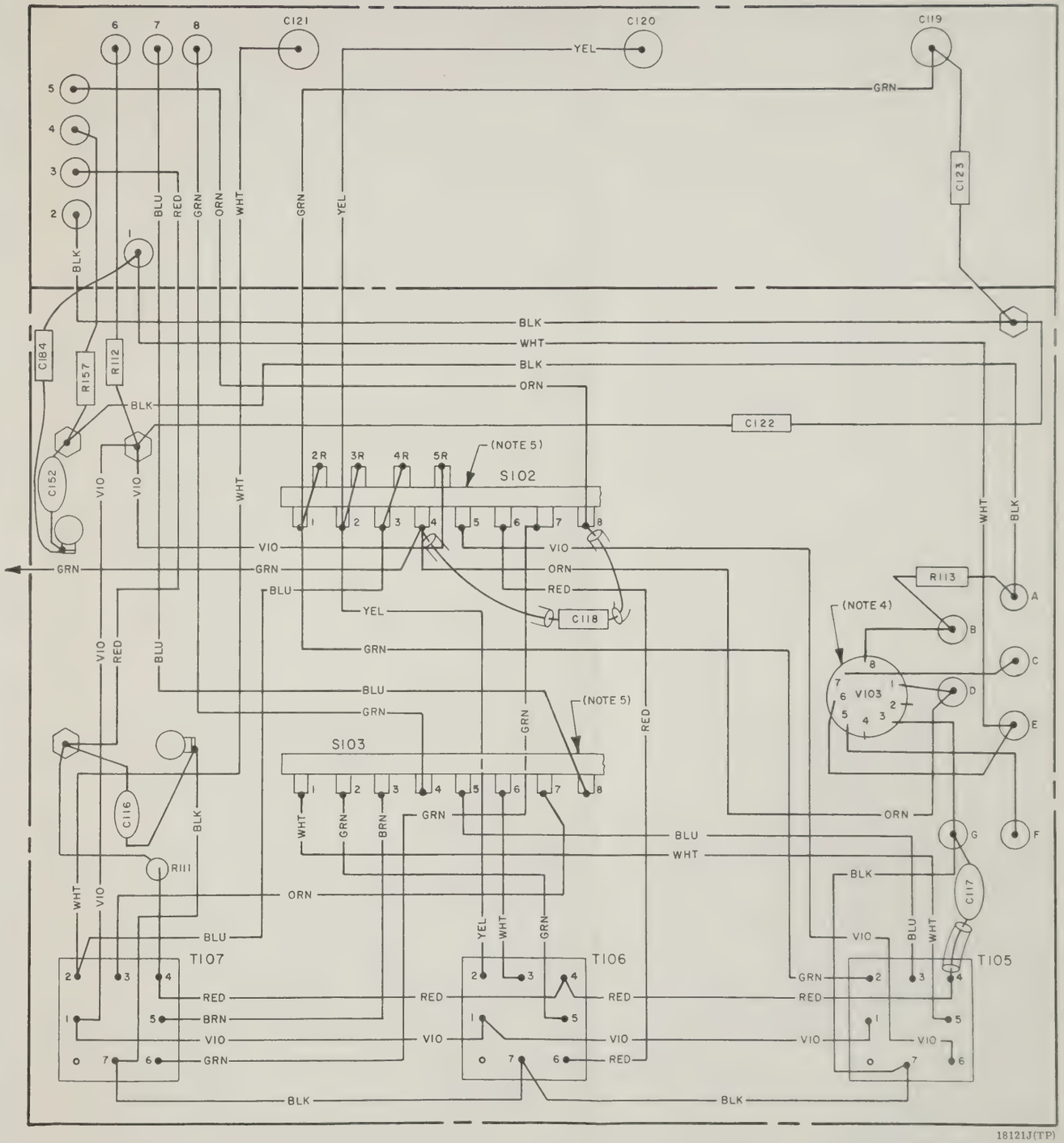


Figure 6–5. R-30B Receiver, Antenna Assembly Z103, Wiring Diagram

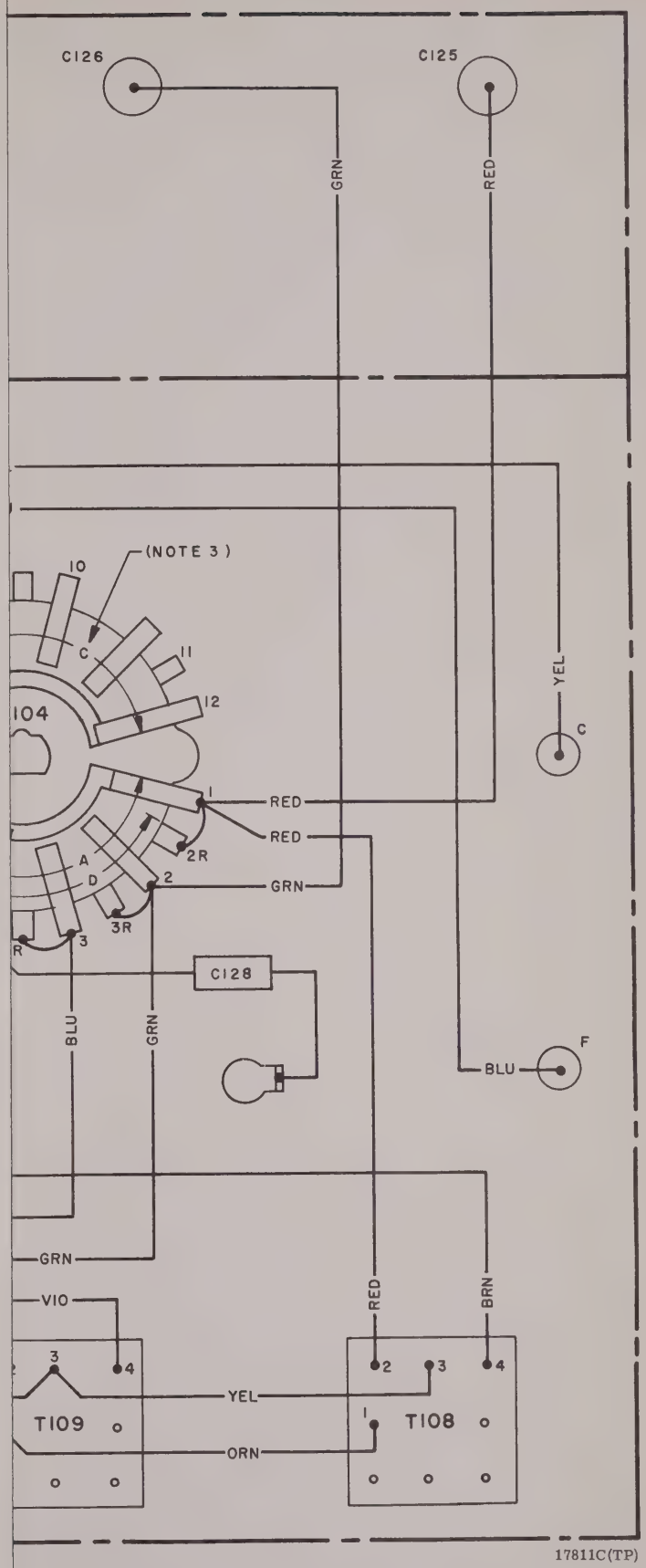


Figure 6–6. R-30B Receiver, First R-f Assembly Z104, Wiring Diagram

NOTES:

1. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
2. UNMARKED WIRES ARE NO. 24 AWG BARE, SOLID COPPER. WIRES MARKED WITH COLOR NOTE ARE NO. 24 AWG SOLID COPPER, TEFLON INSULATED.
3. SWITCH SECTIONS:

SECTION	TERMINALS
S104A	1, 2, 3, 4
S104B	5, 6, 7, 8
S104C	9, 10, 11, 12
S104D	2R, 3R, 4R, 5R

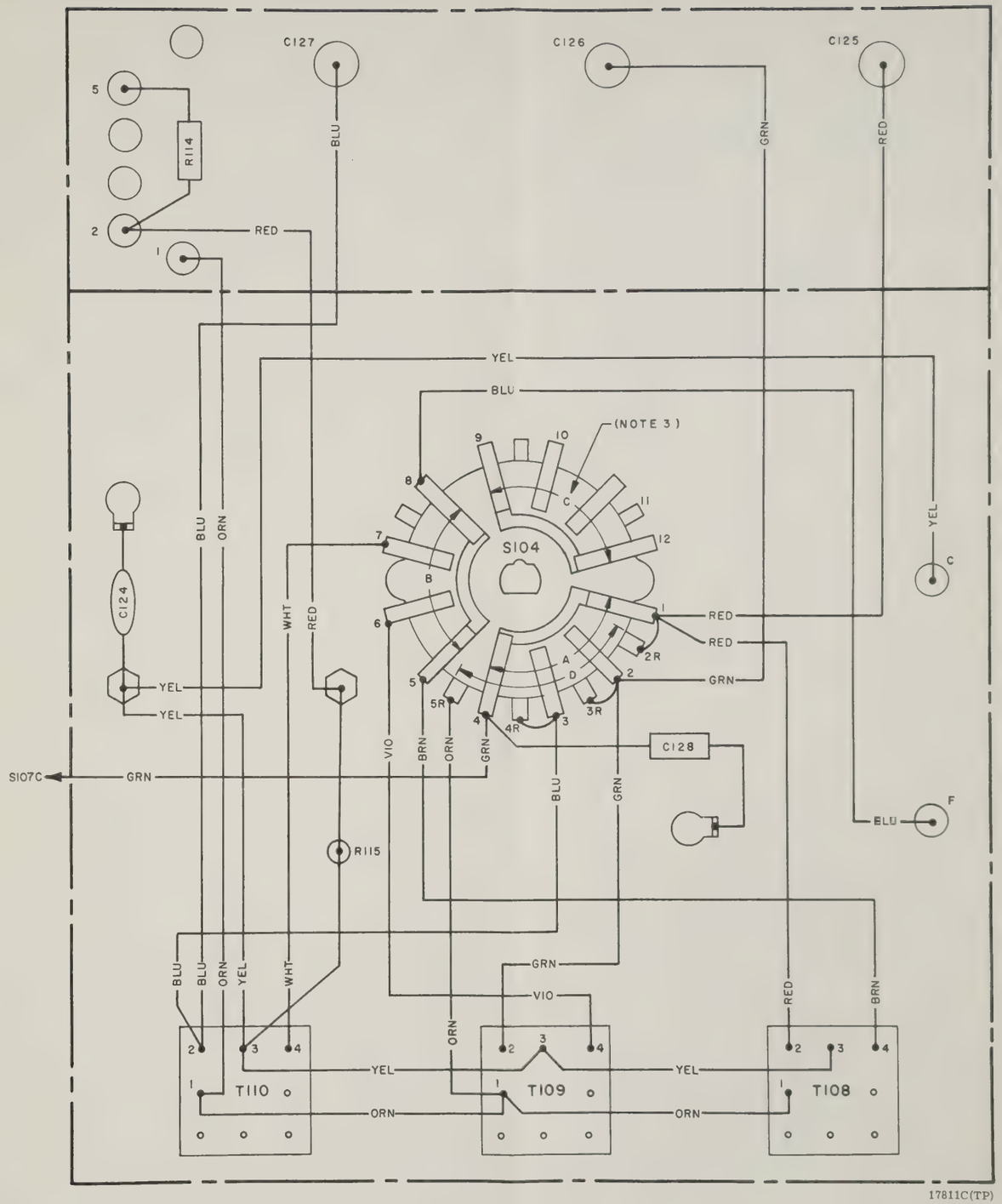


Figure 6–6. R-30B Receiver, First R-f Assembly Z104, Wiring Diagram

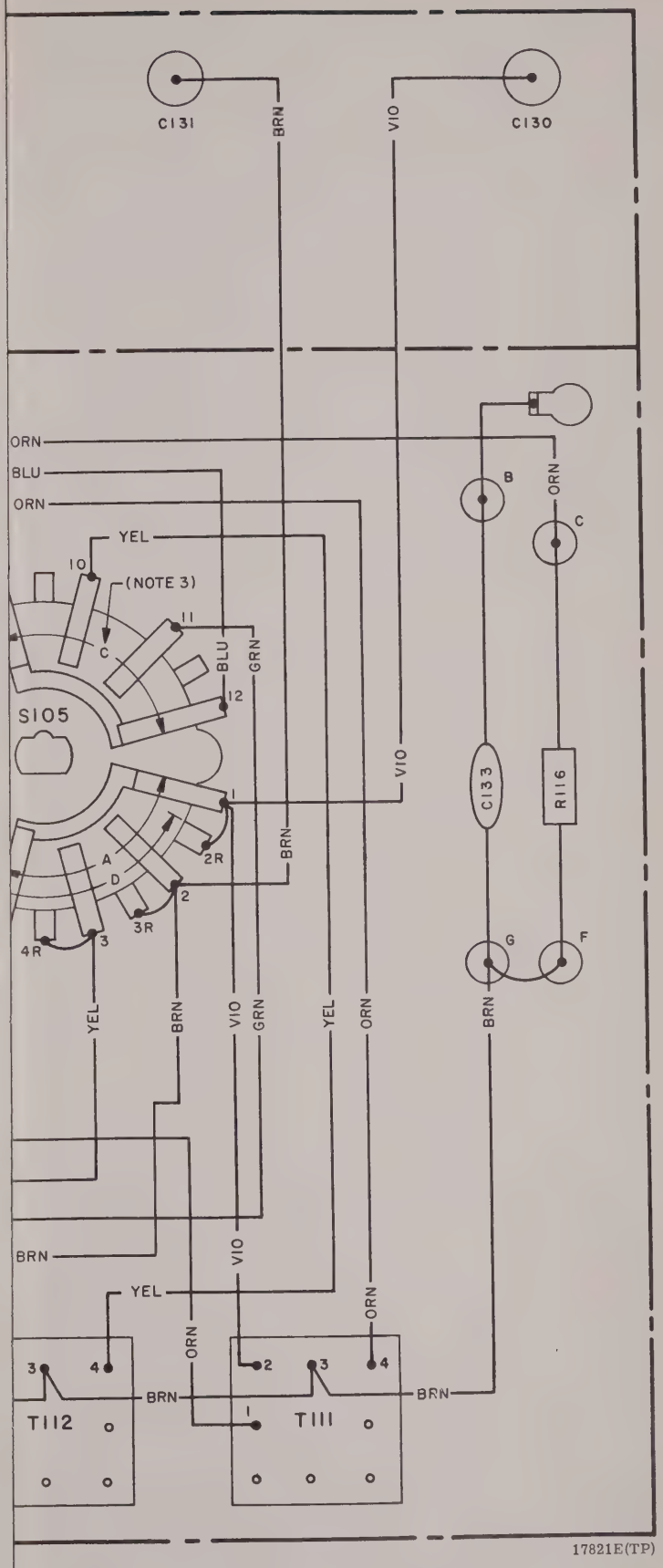


Figure 6–7. R-30B Receiver, Second R-f Assembly Z105, Wiring Diagram

NOTES:

1. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.

2. UNMARKED WIRES ARE NO. 24 AWG BARE, SOLID COPPER. WIRES MARKED WITH COLOR NOTE ARE NO. 24 AWG SOLID COPPER, TEFLON INSULATED.

3. SWITCH SECTIONS:

SECTION	TERMINALS
S105A	1, 2, 3, 4
S105B	5, 6, 7, 8
S105C	9, 10, 11, 12
S105D	2R, 3R, 4R, 5R

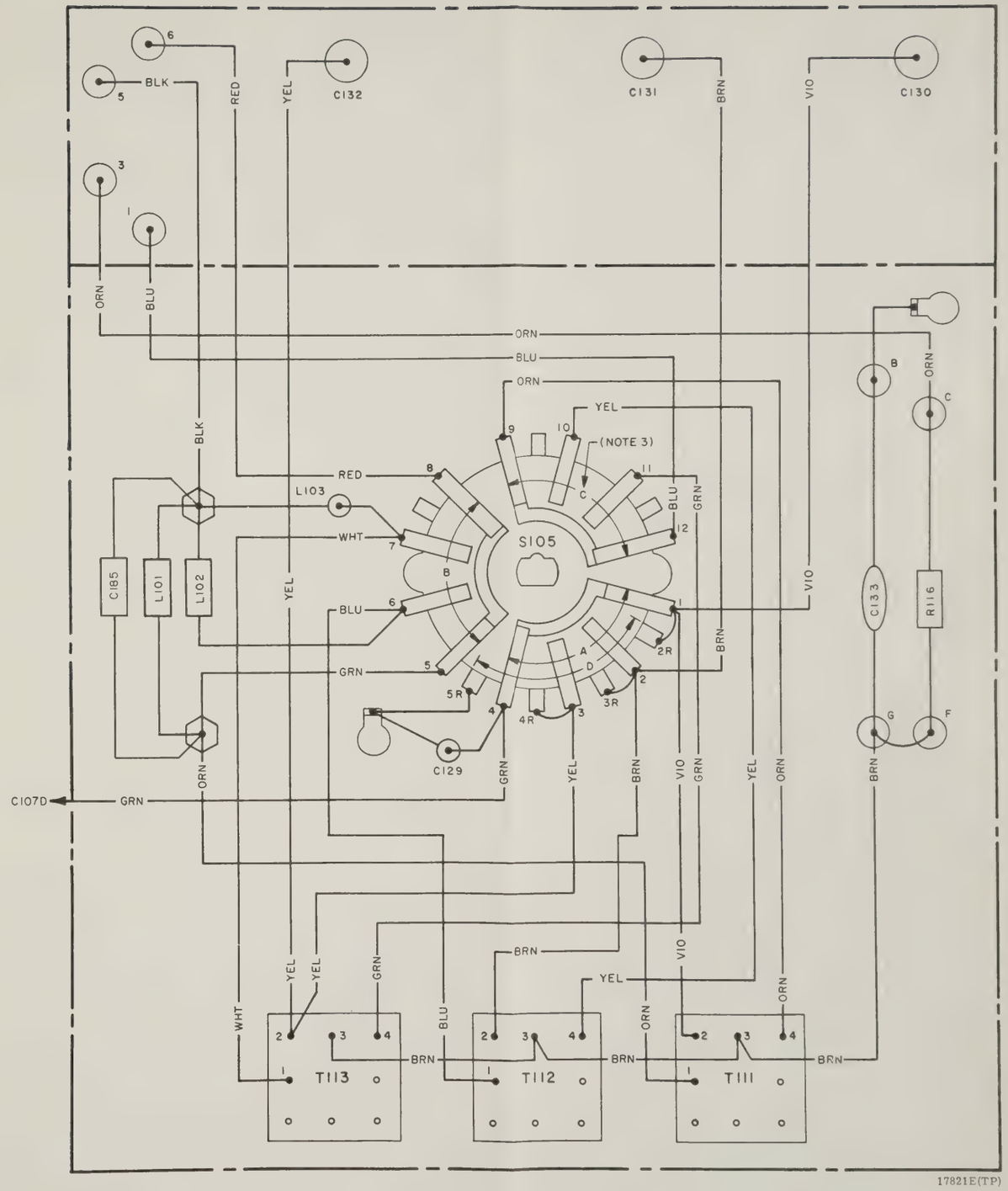


Figure 6–7. R-30B Receiver, Second R-f Assembly Z105, Wiring Diagram

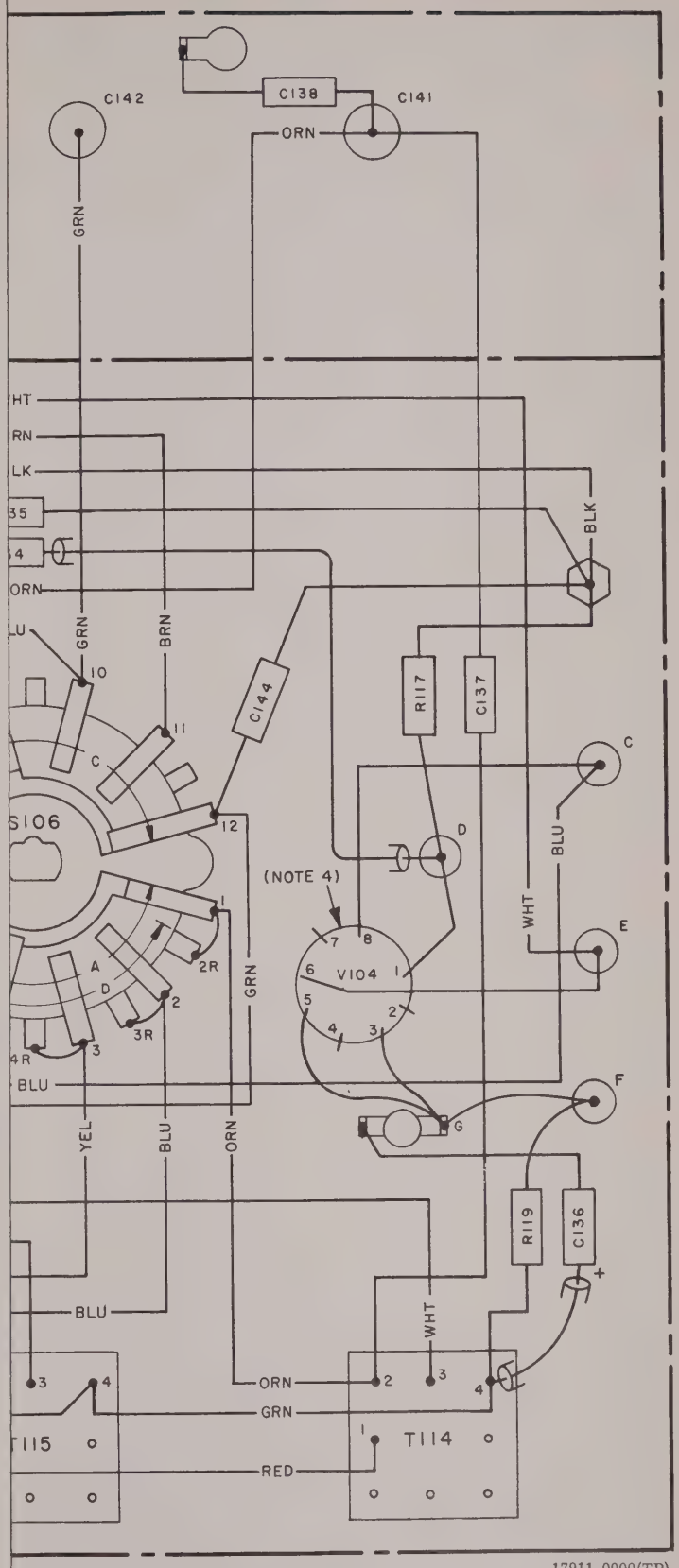
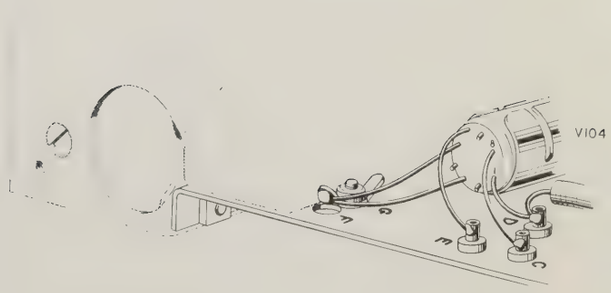


Figure 6–8. R-30B Receiver, Oscillator Assembly Z106, Wiring Diagram

NOTES:

1. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
2. UNMARKED WIRES ARE NO. 24 AWG BARE, SOLID COPPER. WIRES MARKED WITH COLOR NOTE ARE NO. 24 AWG SOLID COPPER, TEFLON INSULATED.
3. PLASTIC COATED FIBERGLASS TUBING OF APPROPRIATE SIZE INSTALLED OVER WIRES MARKED —⊂⊃—.
4. ELECTRON TUBE IS VIEWED TOWARD BASE. TUBE LEADS 1 AND 8 ARE INDICATED TO SHOW PROPER ORIENTATION OF TUBE.
5. SWITCH SECTIONS:

SECTION	TERMINALS
S106A	1, 2, 3, 4
S106B	5, 6, 7, 8
S106C	9, 10, 11, 12
S106D	2R, 3R, 4R, 5R



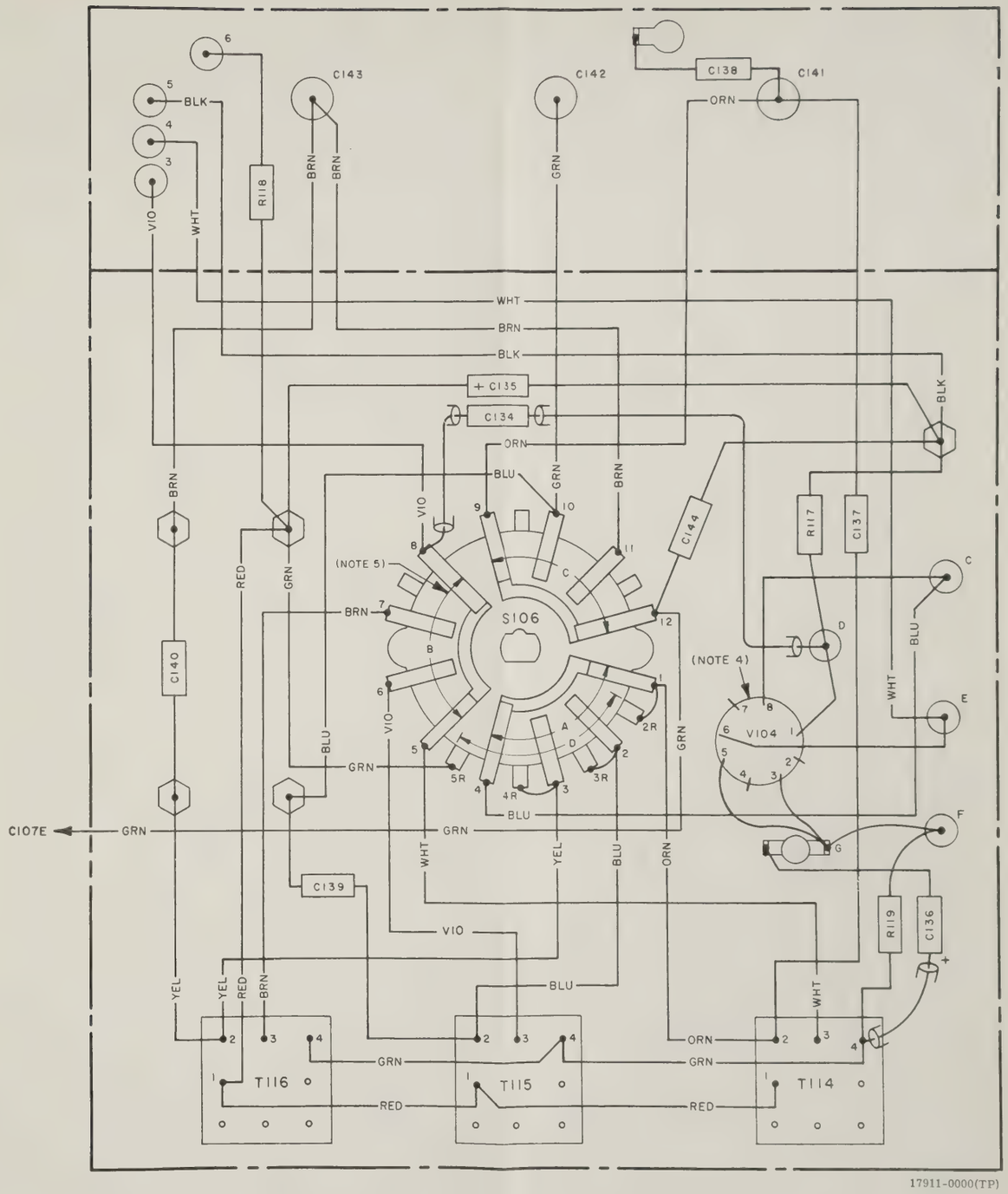


Figure 6–8. R-30B Receiver, Oscillator Assembly Z106, Wiring Diagram

NOTES:

1. FOR WIRING DIAGRAM, SEE FIGURE 6-10.
2. WHEN S201 IS THROWN TO THE LEFT, AS VIEWED FROM FRONT OF PANEL, TERMINALS K AND L ARE CONNECTED TOGETHER AND TERMINAL B IS GROUNDED. WHEN THROWN TO THE RIGHT, TERMINALS K AND M ARE CONNECTED TOGETHER AND TERMINAL B IS GROUNDED.
3. S203 IS MECHANICALLY LINKED TO MASK WHICH CHANGES DIAL PRESENTATION.
4. S204 IS SHOWN IN COMP POSITION.
5. WHEN S205 IS OPEN (ON POSITION), THE BFO IS OPERATING.

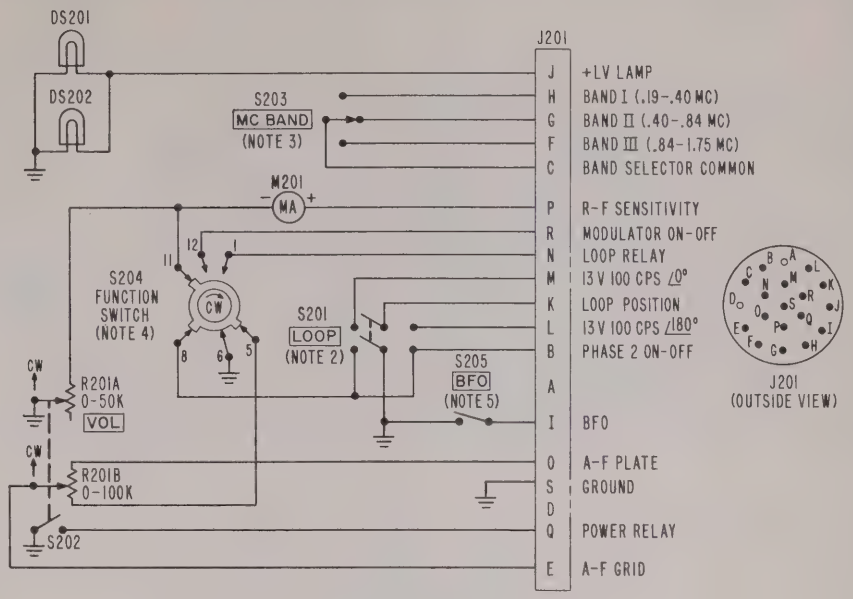


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Figure 6–9. C-59A Control Unit, Schematic Diagram

NOTES:

1. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-9.
2. UNMARKED WIRES ARE NO. 22 AWG BARE, SOLID COPPER. WIRES MARKED WITH COLOR NOTE ARE NO. 22 AWG STRANDED COPPER, TEFLON INSULATED.
3. TRANSPARENT VINYLITE TUBING OF APPROPRIATE SIZE INSTALLED OVER WIRES MARKED —⊖—.

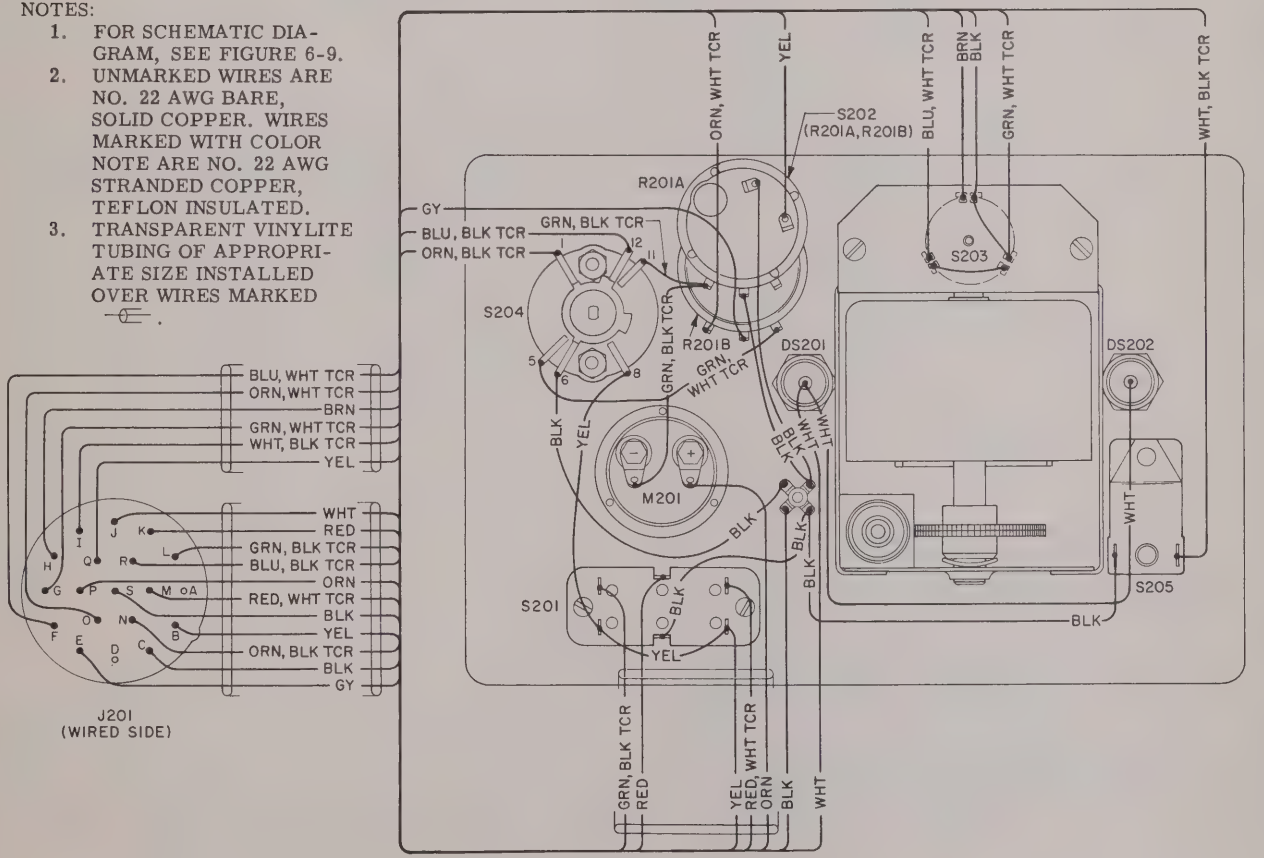

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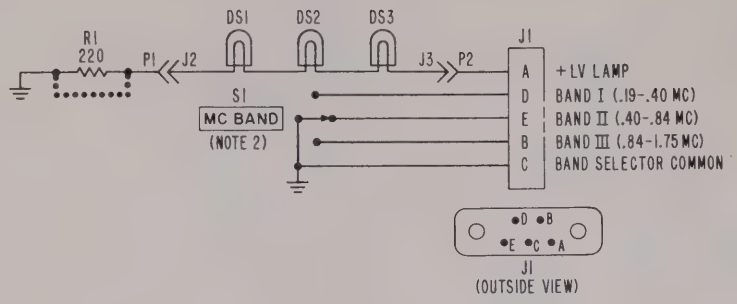
Figure 6–10. C-59A Control Unit, Wiring Diagram



NOTES:

1. FOR WIRING DIAGRAM, SEE FIGURE 6-12.
2. S1 IS MECHANICALLY LINKED TO MASK WHICH CHANGES DIAL SCALE PRESENTATION.
3. FOR 14-VOLT OPERATION, R1 IS OMITTED AND WIRE MARKED •••• IS CONNECTED. FOR 28-VOLT OPERATION, R1 IS CONNECTED AND WIRE MARKED •••• IS OMITTED.

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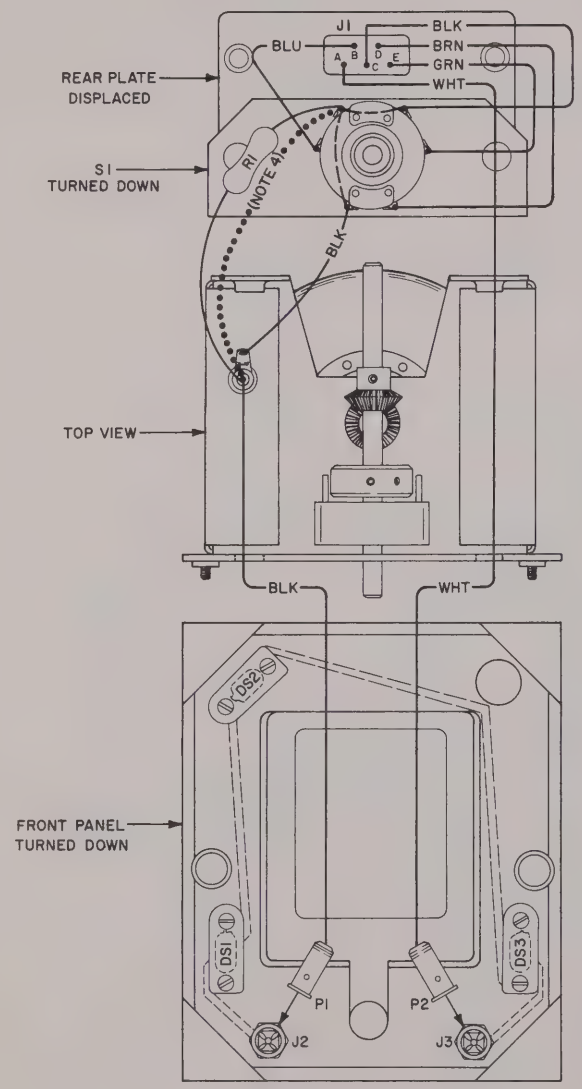
Figure 6–11. CC-14A Control Unit, Schematic Diagram

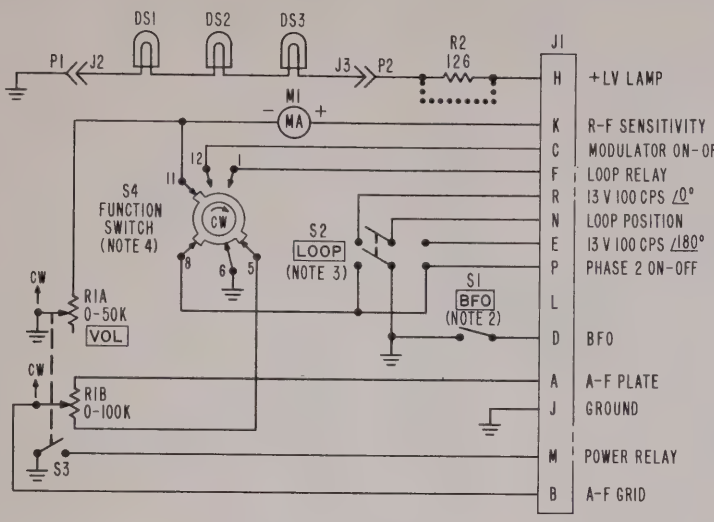


NOTES:

1. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-11.
2. UNMARKED WIRES ARE NO. 22 AWG BARE, SOLID COPPER. WIRES MARKED WITH COLOR NOTE ARE NO. 24 AWG STRANDED COPPER, TEFLON INSULATED.
3. TEFLON TUBING OF APPROPRIATE SIZE INSTALLED OVER WIRES MARKED —⊂⊃—.
4. FOR 14-VOLT OPERATION, R1 IS OMITTED AND WIRE MARKED •••• IS CONNECTED. FOR 28-VOLT OPERATION, R1 IS CONNECTED AND WIRE MARKED •••• IS OMITTED.

27066B(TP)

Figure 6–12. CC-14A Control Unit, Wiring Diagram

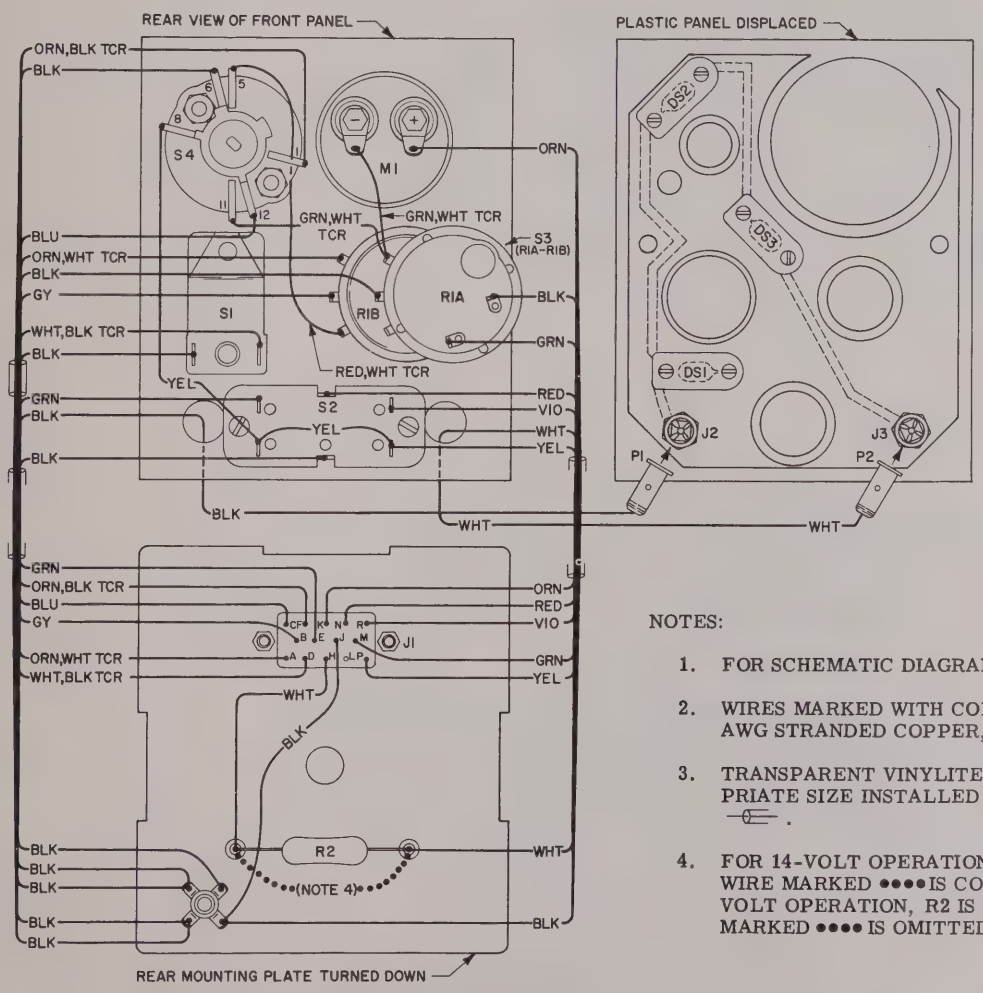


NOTES:

1. FOR WIRING DIAGRAM, SEE FIGURE 6-14.
2. WHEN S1 IS OPEN (ON POSITION), THE BFO IS OPERATING.
3. WHEN S2 IS THROWN TO THE LEFT, AS VIEWED FROM FRONT OF PANEL, TERMINALS E AND N ARE CONNECTED TOGETHER AND TERMINAL P IS GROUNDED. WHEN THROWN TO THE RIGHT, TERMINALS N AND R ARE CONNECTED TOGETHER AND TERMINAL P IS GROUNDED.
4. S4 IS SHOWN IN COMP POSITION.
5. FOR 14-VOLT OPERATION, R2 IS OMITTED AND WIRE MARKED ••• IS CONNECTED. FOR 28-VOLT OPERATION, R2 IS CONNECTED AND WIRE MARKED ••• IS OMITTED.

27067A(TP)

Figure 6–13. CC-15A Control Unit, Schematic Diagram

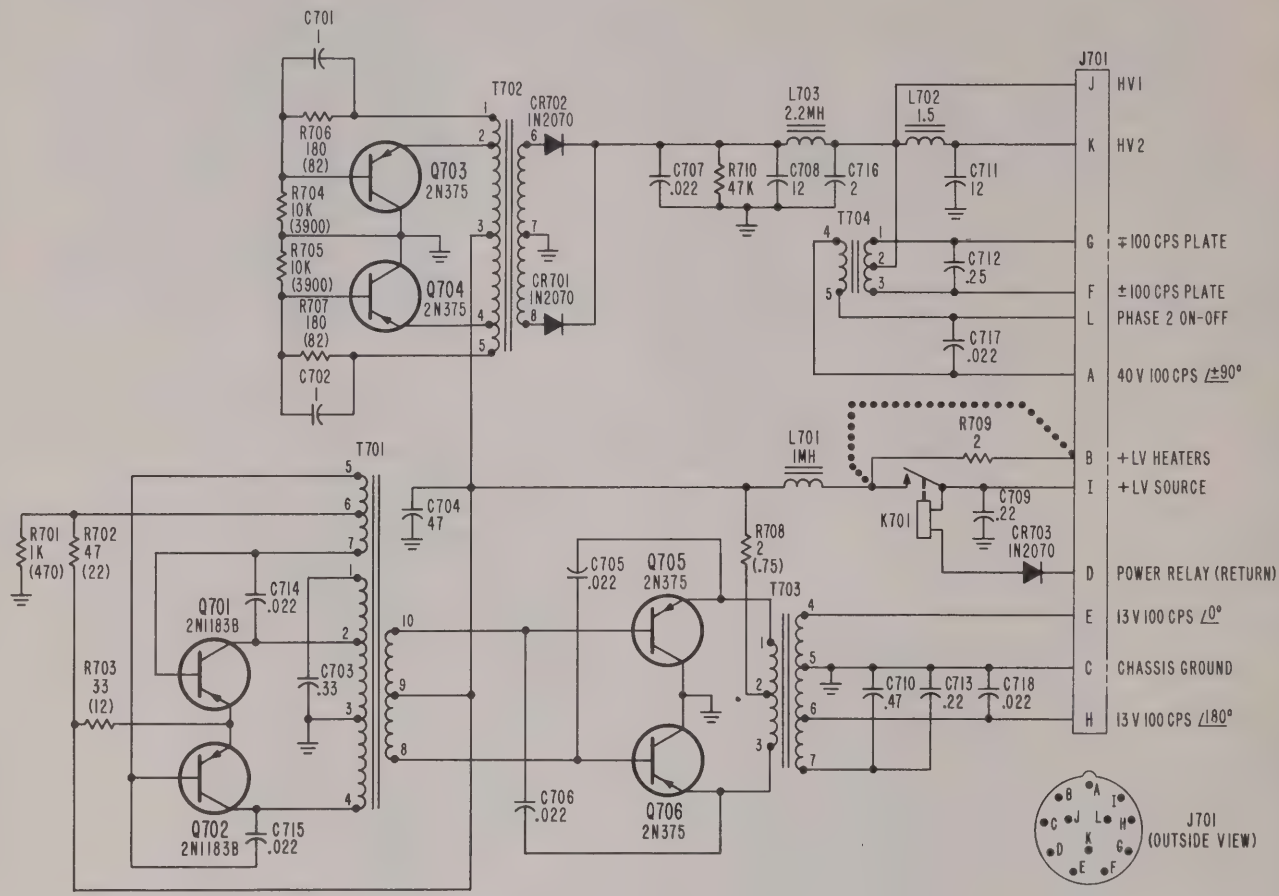


NOTES:

1. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-13.
2. WIRES MARKED WITH COLOR NOTE ARE NO. 24 AWG STRANDED COPPER, TEFLON INSULATED.
3. TRANSPARENT VINYLITE TUBING OF APPROPRIATE SIZE INSTALLED OVER WIRES MARKED —⊂⊃— .
4. FOR 14-VOLT OPERATION, R2 IS OMITTED AND WIRE MARKED ••••IS CONNECTED. FOR 28-VOLT OPERATION, R2 IS CONNECTED AND WIRE MARKED •••• IS OMITTED.

27068A(TP)

Figure 6–14. CC-15A Control Unit, Wiring Diagram

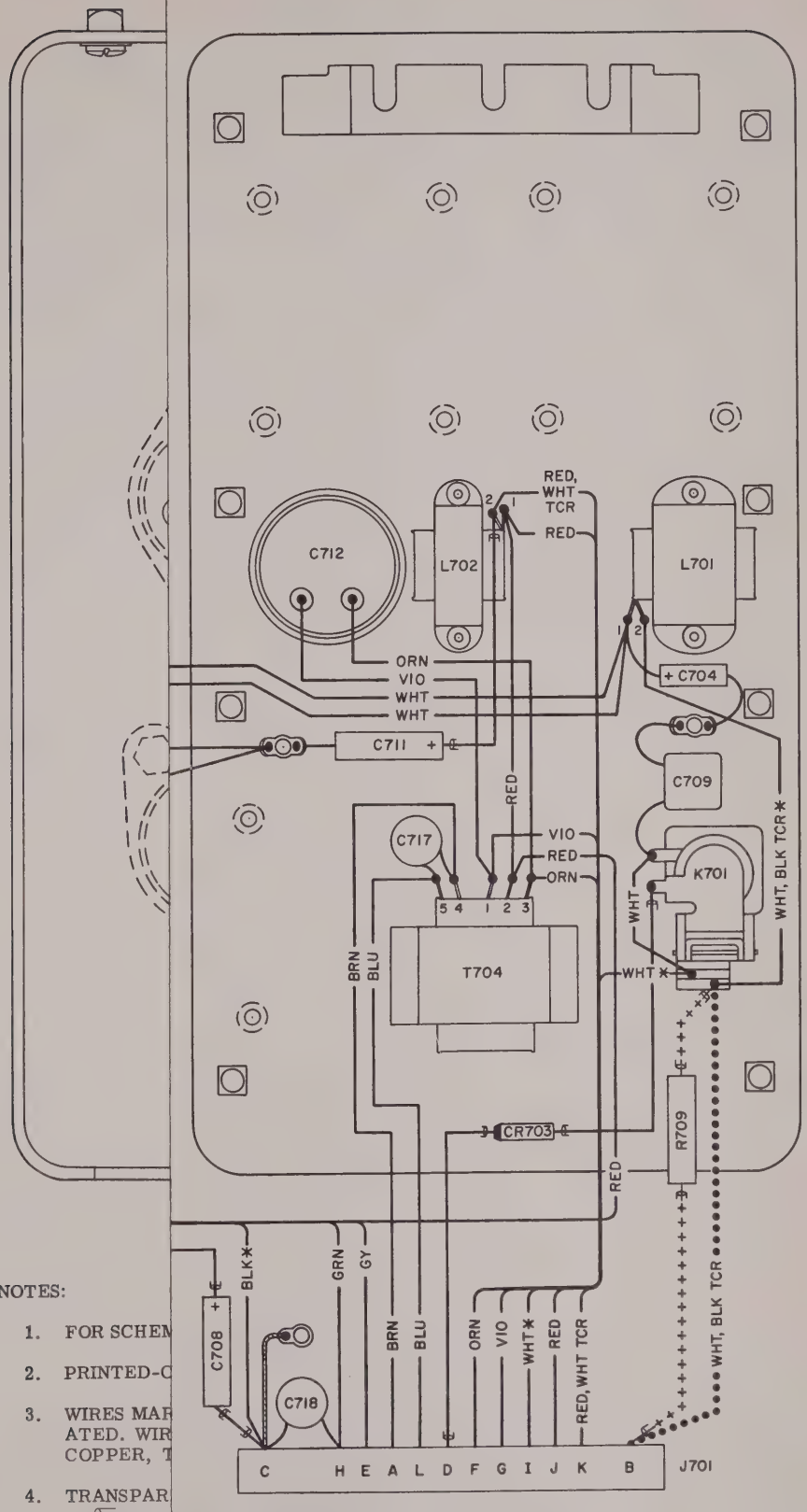


NOTES:

1. FOR WIRING DIAGRAM, SEE FIGURE 6-16.
2. CAPACITOR VALUES ARE IN MICROFARADS (μF), UNLESS OTHERWISE NOTED.
3. INDUCTOR VALUES ARE IN HENRIES (H), UNLESS OTHERWISE NOTED.
4. RELAY IS SHOWN UNENERGIZED.
5. FOR 14-VOLT OPERATION, R709 IS OMITTED AND WIRE MARKED •••• IS CONNECTED. FOR 28-VOLT OPERATION, R709 IS CONNECTED AND WIRE MARKED •••• IS OMITTED.
6. PART VALUES IN PARENTHESES ARE FOR 14-VOLT UNITS ONLY.

24631E(TP)

Figure 6–15. DV-14A Dynaverter, Schematic Diagram



NOTES:

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4. TRANSPAR
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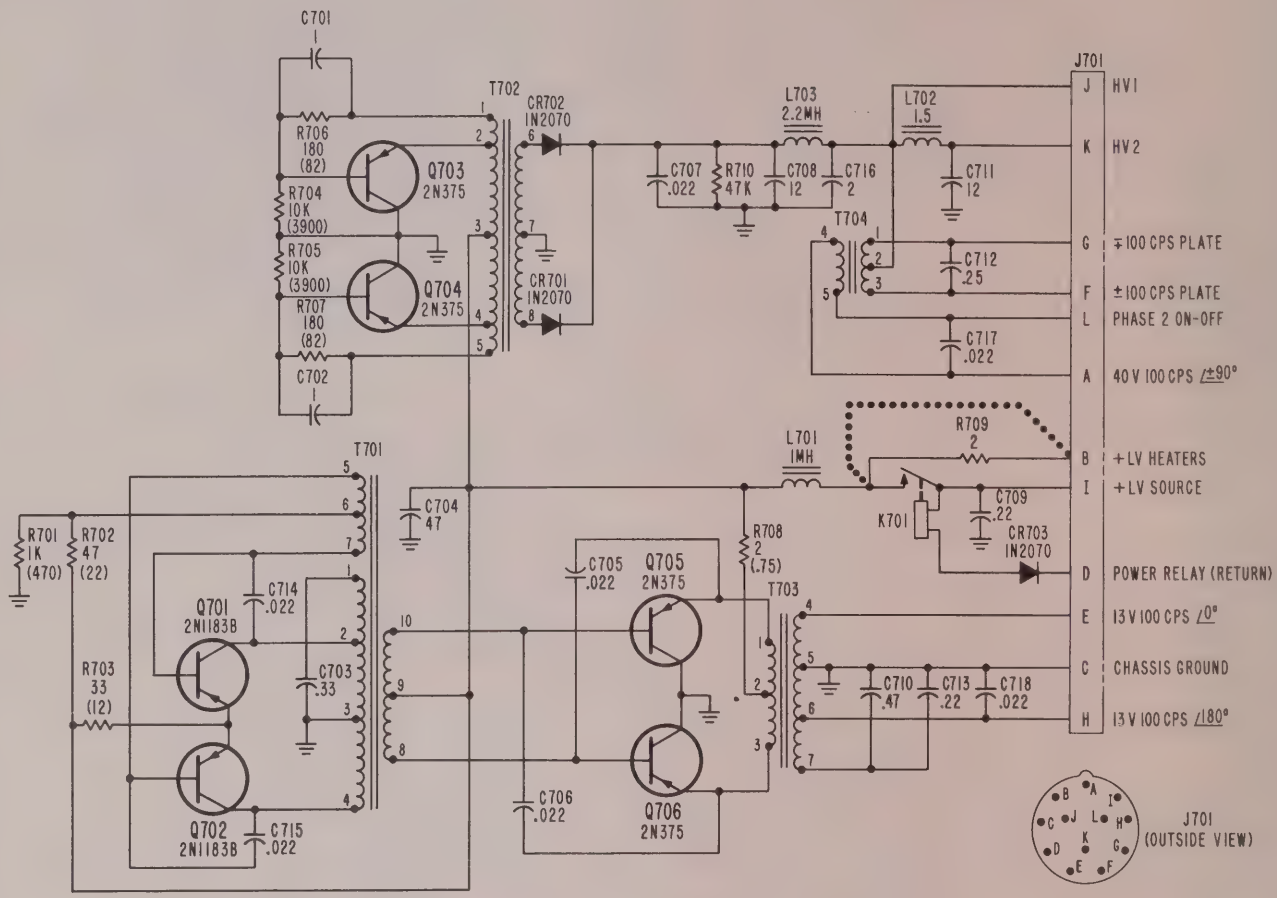
5. FOR 14-VO
28-VOLT O

24632C & 26130F(TP)

Figure 6–16. DV-14A Dynaverter, Wiring Diagram

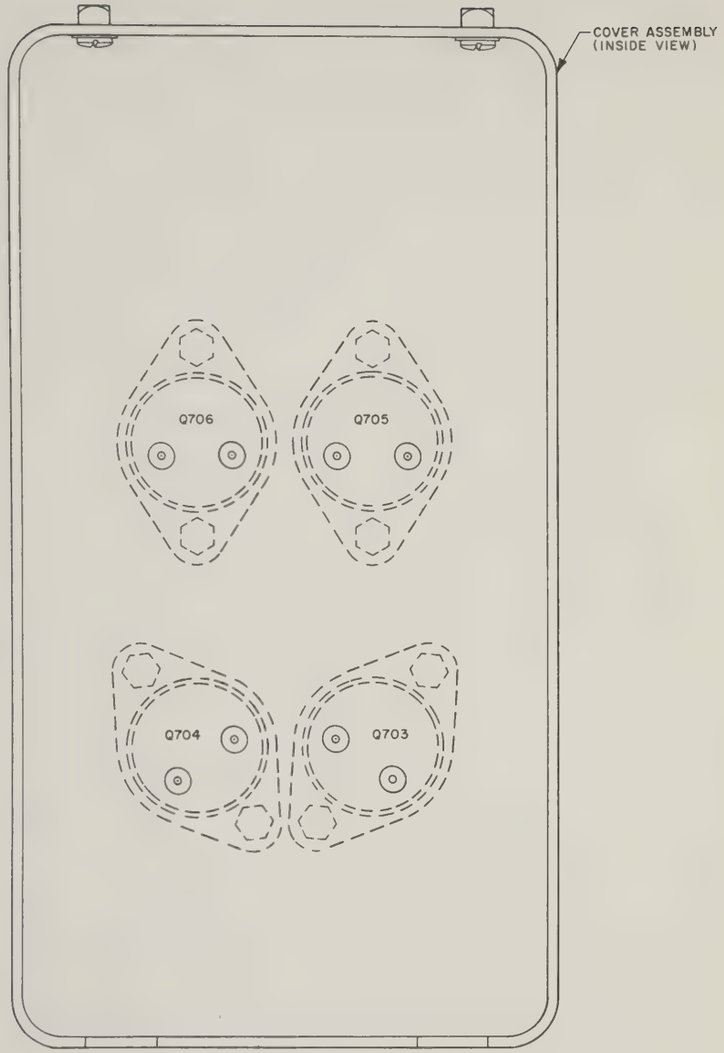


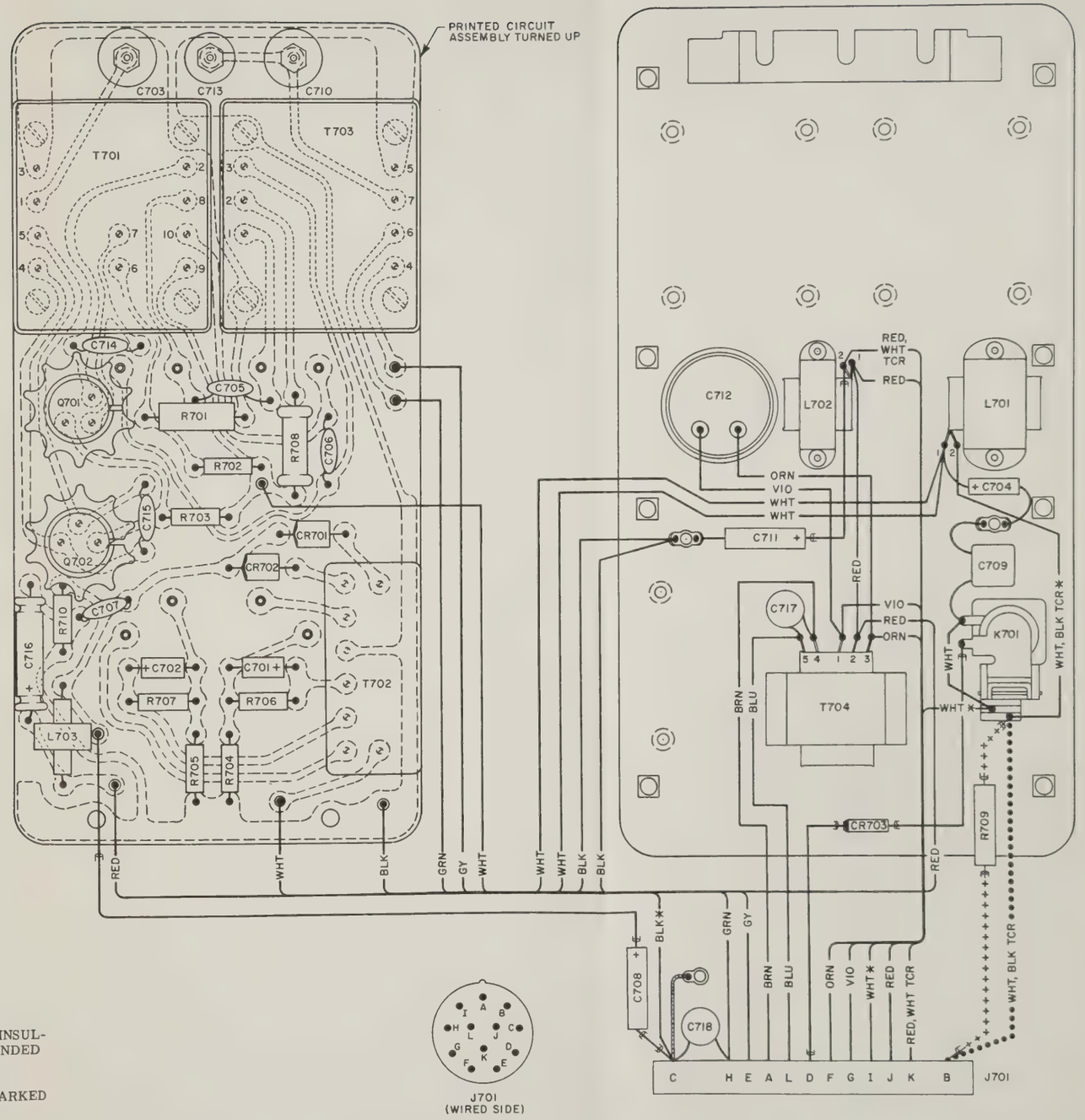
NOTES:

1. FOR WIRING DIAGRAM, SEE FIGURE 6-16.
2. CAPACITOR VALUES ARE IN MICROFARADS (μF), UNLESS OTHERWISE NOTED.
3. INDUCTOR VALUES ARE IN HENRIES (H), UNLESS OTHERWISE NOTED.
4. RELAY IS SHOWN UNENERGIZED.
5. FOR 14-VOLT OPERATION, R709 IS OMITTED AND WIRE MARKED •••• IS CONNECTED. FOR 28-VOLT OPERATION, R709 IS CONNECTED AND WIRE MARKED •••• IS OMITTED.
6. PART VALUES IN PARENTHESES ARE FOR 14-VOLT UNITS ONLY.

24631E(TP)

Figure 6–15. DV-14A Dynaverter, Schematic Diagram





NOTES:

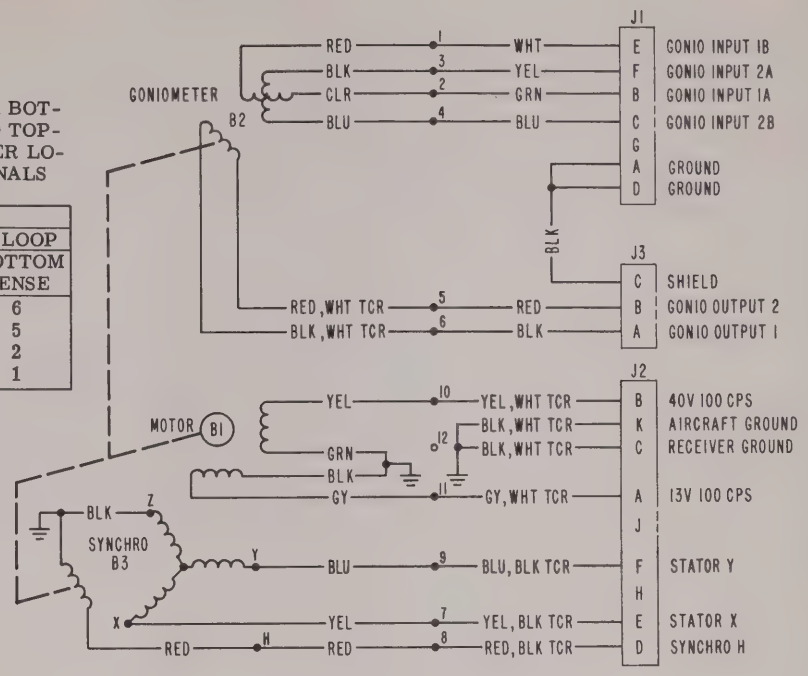
1. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-15.
2. PRINTED-CIRCUIT ASSEMBLY SHOWN INVERTED.
3. WIRES MARKED WITH COLOR NOTE ARE NO. 24 AWG STRANDED COPPER, TEFLON INSULATED. WIRES MARKED WITH COLOR NOTE AND ASTERISK (*) ARE NO. 22 AWG STRANDED COPPER, TEFLON INSULATED.
4. TRANSPARENT TEFLON TUBING OF APPROPRIATE SIZE INSTALLED OVER WIRES MARKED —⊖—.
5. FOR 14-VOLT OPERATION, R709 IS OMITTED AND WIRE MARKED•••• IS CONNECTED. FOR 28-VOLT OPERATION, R709 IS CONNECTED AND WIRE MARKED•••• IS OMITTED.

24632C & 26130F(TP)

Figure 6–16. DV-14A Dynaverter, Wiring Diagram

NOTE:
IN-21B IS INTERNALLY WIRED FOR A BOTTOM-MOUNTED LOOP ANTENNA AND TOP-MOUNTED SENSE ANTENNA. IF OTHER LOCATIONS ARE USED, REWIRE TERMINALS AS FOLLOWS:

WIRE COLOR	TERMINAL NUMBER			
	TOP LOOP		BOTTOM LOOP	
	TOP SENSE	BOTTOM SENSE	TOP SENSE	BOTTOM SENSE
RED	6	5	5	6
BLACK	5	6	6	5
GREEN	1	1	2	2
WHITE	2	2	1	1

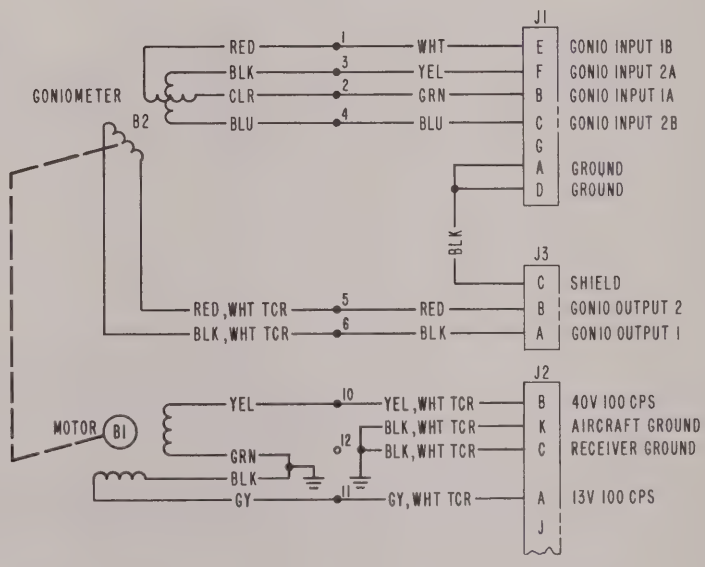


P/O 32670D(TP)

Figure 6–17. IN-21B Goniometer-Indicator, Schematic Diagram

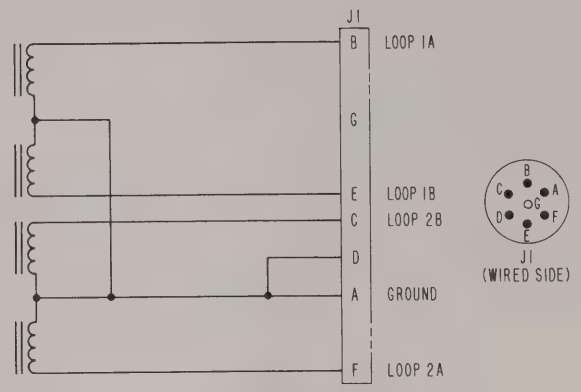
NOTE:
IN-21C IS INTERNALLY WIRED FOR A BOTTOM-MOUNTED LOOP ANTENNA AND TOP-MOUNTED SENSE ANTENNA. IF OTHER LOCATIONS ARE USED, REWIRE TERMINALS AS FOLLOWS:

WIRE COLOR	TERMINAL NUMBER			
	TOP LOOP		BOTTOM LOOP	
	TOP SENSE	BOTTOM SENSE	TOP SENSE	BOTTOM SENSE
RED	6	5	5	6
BLACK	5	6	6	5
GREEN	1	1	2	2
WHITE	2	2	1	1



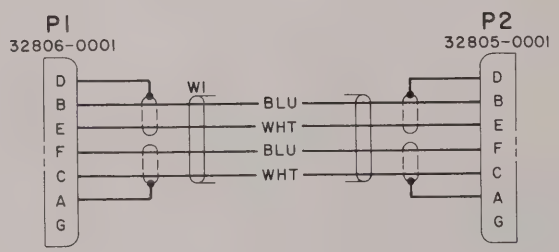
P/O 33550D(TP)

Figure 6–18. IN-21C Goniometer-Indicator, Schematic Diagram



32882B(TP)

Figure 6–19. L-40B Loop Antenna, Schematic Diagram



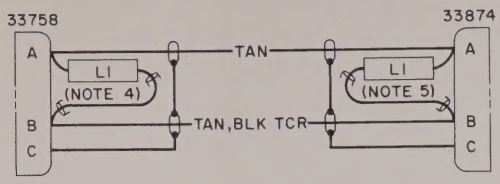
NOTES:

1. EACH WIRE OF CABLE MARKED W1 IS NO. 30 AWG STRANDED COPPER, TEFLON INSULATED: A BLUE WIRE AND A WHITE WIRE ARE PAIRED IN A COMMON SHIELD HAVING A VINYLITE JACKET.

2. VINYLITE TUBING OF APPROPRIATE SIZE INSTALLED OVER WIRES MARKED ⊖ .

32803B(TP)

Figure 6–20. Loop Antenna Cable Assembly 32803, Wiring Diagram



NOTES:

1. WIRES MARKED WITH COLOR NOTE ARE NO. 36 AWG INSULATED COPPER, INDIVIDUALLY SHIELDED WITH COMMON JACKET.
2. PLASTIC COATED FIBERGLASS TUBING OF APPROPRIATE SIZE INSTALLED OVER WIRES MARKED —⊂⊃—.
3. RECEIVER CABLE ASSEMBLY IS AVAILABLE IN A 10-FOOT (33785-0010), 20-FOOT (33785-0020), AND 30-FOOT (33785-0030) LENGTH.
4. VALUE: 180 MICROHENRIES. USED ONLY IN 33785-0020 (20-FOOT).
5. VALUE: 68 MILLIHENRIES. USED ONLY IN 33785-0030 (30-FOOT).

33785A(TP)

Figure 6–21. Receiver Cable Assembly 33785, Wiring Diagram

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